THE

ELECTRICAL REVIEW.

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DESTRUCTORS AND CENTRAL STATIONS.

OUR columns have from time to time borne witness to the great interest taken by central station engineers in the question of refuse destructors, and the hopes that have been entertained that by adapting these useful sanitary appliances to the purpose of steam raising, a considerable reduction could be made in the cost of this item where a central station and refuse destructor plant were combined. We recently gave some particulars of the St. Pancras and Shoreditch schemes, while the whole question was dealt with very fully for us by Mr. T. Tomlinson some time ago.

Prof. Forbes has been, amongst other things, one of the leading exponents of the destructor theory as applied to electric lighting. His footsteps have been followed by Mr. Manville and others, who have also put forward recommendations to certain local authorities that combined electric lighting and destructor plants could be advantageously and efficiently worked. Within the last year or two we consider that this subject has received a rather severe check through the ill-considered statements and claims of a company which held the patents for a peculiar form of Lancashire boiler, and who, on the strength of this, endeavoured to persuade the public that what could not be done by a good steam boiler of a recognised type, was possible with their pattern. The value of refuse destruction as an economic auxiliary to an electric lighting plant is now, however, being tested on sufficiently broad lines, and the results will soon be widely enough known to enable engineers to form an opinion based on facts, and not, as before, on assumptions and postulates.

In conversation with some of the most experienced central station managers in London and the provinces, we have learned that they do not altogether regard refuse destruction as of importance at the present time, except on purely sanitary grounds. On the other hand, Mr. Manville, whose connection with the Shoreditch scheme renders anything he may say of interest, has recently presented a paper to the Northern Society of Electrical Engineers, in which he outlines the position as it appears to him. Since he has put, or is carrying, his theory into practice, we may regard this paper much more seriously than some of those that have preceded it. Perhaps the inclusion of Halpin's thermal storage system into the designs for Shoreditch add to the eagerness with which engineers look for any information regarding this plant. Hot-feed only was accepted when the contracts were let, but we should not be surprised to find that thermal storage proper is taken up at an early stage in the history of this undertaking. Mr. Manville clearly states, what must show municipal engineers that he appreciates the position, that whatever our efforts may be to efficiently utilise the waste heat from destructors to evaporate water,

they must always be subservient to the complete and effective destruction of the refuse and the empyreumatic vapours given off by its destructive distillation, and on no consideration must this complete burning be interfered with; otherwise, the refuse could be burned on the fire grates of ordinary boilers, where a higher evaporative efficiency would probably be obtained.

Mr. Manville considers that it is by the utilisation of the heat produced by the destruction of ash-bin refuse that we may look to the cost of the production of electricity being materially reduced, and computes the reduction at about one-third of the existing average "works' costs." That anything approaching this figure is to be looked for, has yet to be proved in practice. We believe that the utmost at present being got out of the St. Pancras cells, at the King's Road station, is sufficient heat for the economiser, and enough to keep a stand-by boiler with steam at 45 lbs. pressure. At Ealing, again, the waste gases from the destructor had not, a very short time ago, if our information is correct, been used once for steam raising purposes, and we could say more on this matter, only we prefer to keep our remarks over for some suitable occasion in the near future. Many engineers, whose experience entitles their views to be treated with respect, have never looked very kindly upon the combination of refuse destructors and electric lighting. It is possible that the combination of refuse destruction, thermal storage, and electric lighting may alter these views; at any rate there are reasonable grounds for concluding that if destructors are to prove of real use, the advantages therefrom will be due to the possibility of certain methods of working being adopted that are made possible by the introduction of thermal storage. Prof. Unwin's report on thermal storage must be regarded as an important point in its favour, and where it has been tried the results have been encouraging. Where a destructor is combined with a central station it must not be forgotten that, in the event of the destructor failing to give what was expected, the electricity works are saddled with the expense of extra buildings and plant; while, if the boilers have been specially arranged to obtain the benefits of the destructor gases, and these benefits turn out to be fallacious, the boiler plant would in all probability not work at their best efficiency when coal alone is used.

Destructors can now be worked without nuisance, and Mr. Manville tackles the difficulty at both ends. He would use forced draught to obtain a high temperature, and clinch matters by adding a Jones's cremator—*i.e.*, a secondary furnace in which is burnt continuously a coke fire, over which all the gases from the refuse furnaces have to pass, and in which the temperature is raised to the required degree. The low evaporation only of so-called ash-bin refuse is attributed in the paper to excessive radiation from the large masses of brickwork usually forming part of a destructor, and to a too sparing allowance of heating surface in the boilers. Second only to these, Mr. Manville attacks the practice of mixing incombustible matter with refuse, and crediting the mixture with a low evaporative efficiency, and mentions the case of one gentleman—well known in connection with refuse destruction—who has from time to time stated that in his belief no such horse-power as talked about by others could be obtained from ash-bin refuse, but on investigation it was found that this refuse was enormously diluted with street sweepings before it was burned in the destructor.

We have followed this development very closely, and must confess that over sanguine views seem to have been adopted by many consulting engineers. That during hours of light load a destructor may provide steam, or that even during heavy loads this, combined with thermal storage, may aid economical working, may be accepted, but the advantages are purely financial, and must be judged by a financial balance-sheet. At present, no favourable balance has been shown, and it behoves central station engineers to consult their municipal brethren before entering a new field.

The Definition of Low Pressure.

In another column we give the report of the Committee appointed by the Board of Trade to consider whether it is desirable that the limit of low pressure as at present defined should be altered, and if so, to what value. It will be remembered that this was suggested by Sir Courtenay Boyle at the second day's meeting of the recent conference as being the most equitable means of sifting the large volume of evidence given at that conference. The first alteration is in the definition of how an alternating pressure is to be measured, and this we take to be a concession to those who use electrostatic voltmeters, as is now general. "Pressure" now means simply "the difference of electrical potential between any two conductors through which a supply of energy is given, or between any part of either conductor and the earth." By inference, a low-pressure supply becomes one in which the pressure can never exceed 500 volts if continuous, or 250 volts if alternating; a high-pressure supply is one between 500 and 3,000 volts for continuous currents, and 250 volts and 3,000 volts for alternating currents, and an extra high pressure, anything over 3,000 volts, on either system. The pressure may not be changed at any consumer's terminals without his consent. In our issue of a fortnight ago, we pleaded for three things that have not been granted, but which we considered vital to the best interests of the industry; these were, that practical and experienced station engineers should be included on the committee, that the meeting should be open to the public, and that no difference should be made between continuous and alternating currents. By the failure to grant these points, we think that the conclusions of the Committee are unsatisfactory, and will not be accepted without demur by a large proportion of the electrical engineering profession.

Phenomenal Success at Edinburgh.

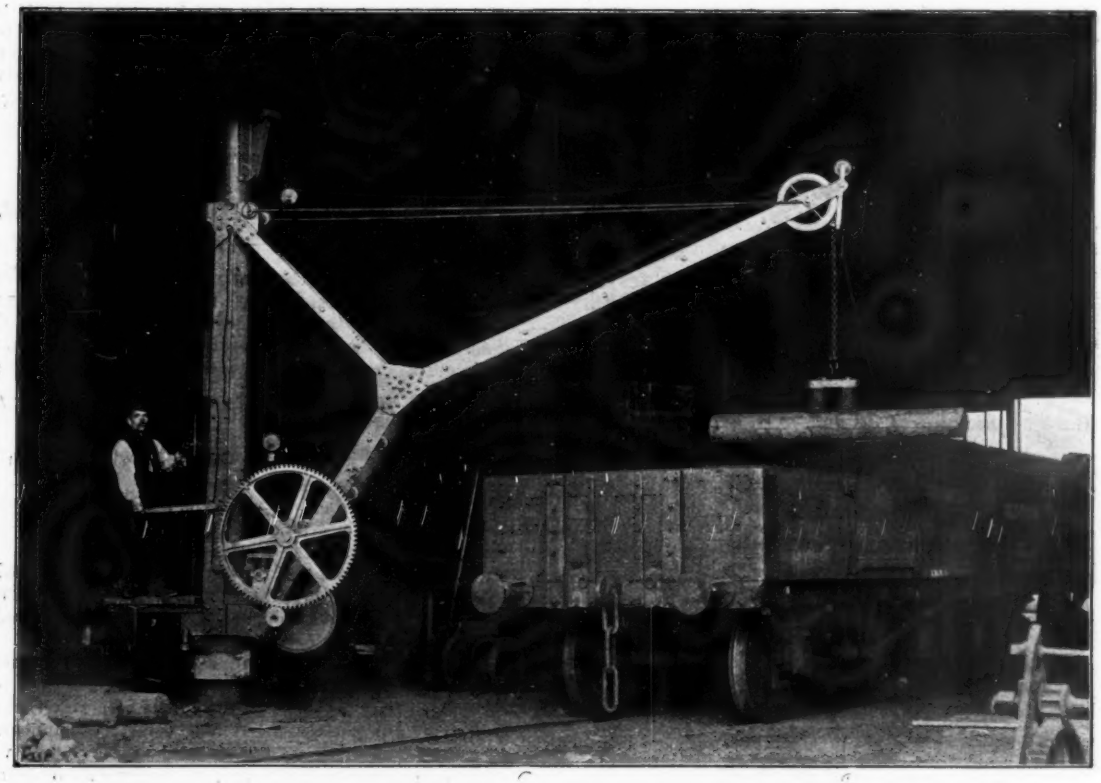
Although the exceptional success obtained at the Edinburgh Corporation Electric Lighting Station, under Mr. Monkhouse's management, has been freely spoken of during the last two or three weeks, Prof. Kennedy's report on the extension of the plant reveals some very exceptional figures. Prof. Kennedy, in his original report, said that the station expenses per unit would probably be 3d. when the output was 300,000. The total number of units sold in 34 weeks is 285,000, but the station expenses are only 1·56d. per unit sold. It was suggested that in two years' time 40,000 lamps might be connected; the number after 7½ months' working is equivalent to 42,300. Under these circumstances, it is not surprising that the Electric Lighting Company recommend the extensions. In spite of many conspicuous successes, few works have in so short a time attained the position of those at Edinburgh. No doubt the energy of the Committee, and the peculiar conditions of Edinburgh, have done much; but the design of the system, and its subsequent management, must account for a good deal. We have reproduced Prof. Kennedy's report in another place, for his remarks—especially those on the 200-volt lamp question—will, no doubt, be of great interest.

ELECTRIC CRANES AND MAGNETS FOR LIFTING PURPOSES.

We referred last week to the interesting use that is being made of magnetism at the Sandycroft Works for lifting purposes. At these works electric cranes are operated from the electric power and lighting circuits, together with electro-magnets, which permit the ready lifting of pieces of iron or steel weighing up to 2 tons.

As we have pointed out, this is a novel and practical application of electro-magnets, and one which has been found to save much time and labour in the operation of unloading, loading, packing, and moving generally of pieces which would otherwise require much expense in securing by chains or ropes.

Fig. 1 shows an electric jib crane, constructed and used in the Sandycroft Works under patents of Dr. N. S. Keith, lifting a 1 ton billet of steel from a railway waggon. These billets are used for forging into shoes and dies for gold ore stamp mills.



Electric Crane with Magnetic Lifter.—Fig. 1.

The magnet takes 5½ ampères at 110 volts to excite it, at which energy it will support a weight of 2 tons of iron or steel. By this crane or magnet we understand that three men do the work in one quarter of an hour which previously took six men one hour and a half to perform.

Fig. 2 shows another magnet used in the shipping department of the works.

The piece which it is holding up weighs 1,800 lbs., and is a cast-iron "Jaw" for a rock-breaker. By the use of the magnet, the handling of iron pieces weighing over 1 cwt., in packing and shipping, is done in less than one half of the time previously required.

The switch at the top enables the putting on and off the electric current. The pole-ends are made of a peculiar shape and longer than necessary for simple lifting purposes, being specially shaped for packing certain iron pieces in boxes. The hook between the limbs is for attaching slings for lifting non-magnetic substances. This magnet weighs 250 lbs., and takes 2 ampères at 110 volts to energise it.

It must be admitted that the use of an electro-magnet for the foregoing purposes must be exceedingly convenient, and in closely packing iron or steel bars in railway trucks it must be admirably suited. But how far electro-magnetic devices can be used for safely moving masses of iron and steel over shop floors remains to be seen. Providing there is no break in the electric circuit, there would be little to apprehend; and, if one can ensure absolute immunity from such a contingency, there is little, to our mind, to prevent a wider use of magnets for lifting purposes.

ONE HUNDRED MILES AN HOUR.

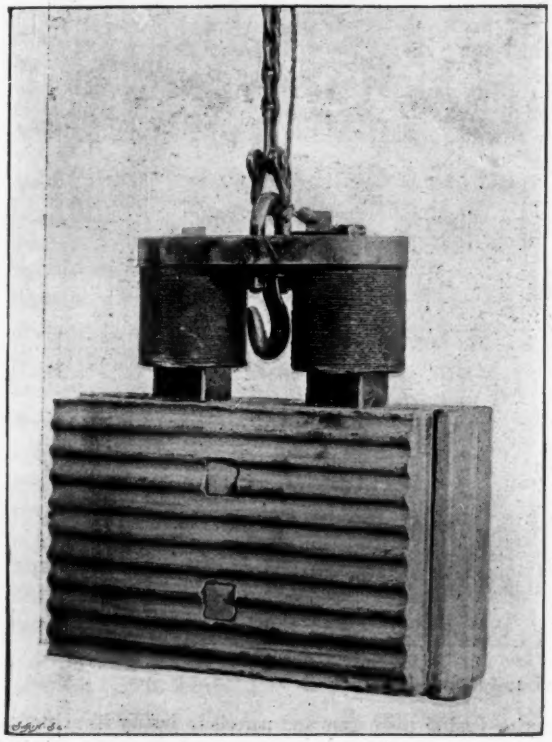
The *Electric Railway Gazette* discusses the question of speed of 100 miles per hour, in relation to the advantages of electricity over steam. With steam the limit for long distance is 65 miles per hour, but a velocity of 90 miles has been reached for short distances. Apart from the extra vigilance necessary with high speeds there must always be great expense attendant on a high-speed train, and it must have a sufficient paying load of passengers and parcels to justify its existence. The best record on the Lake Shore and Michigan line was made with a 92-ton engine drawing a train of 152 tons. This small relative train load is usual in all American practice, and we have noted, as a rule, that a given train load always seems there to demand a greater engine power than is the case here, the reasons for which we may refer to later. Our contemporary, however, assumes it possible to use a 100-ton engine to draw a 200-ton train at 100 miles velocity on an average grade of 0·5 per cent., *i.e.*, 1 in 200. At very high speeds the ordinary tractive resistance of 15 lbs. per ton has been stated to be as low as 10 lbs. There seems to be good reason for this in the reduced time allowed for the depression of the rails beneath the wheels. Given a certain deflection of a length of rail between two supports the time occupied by a wheel in traversing one-half this span must be equal to the time required for a body to fall freely by gravity through a height equal to the deflection. If the velocity of the wheel be greater than this it will enable the wheel to traverse the span without producing the full deflection. In American practice the general disposition of load on the per-

manent way is more concentrated than is the case in English practice, and this undoubtedly may be a chief cause of such heavy resistances.

Taking, then, 10 lbs. per ton, on level ground, a train of 300 tons, including engine, will demand at 100 miles velocity no less than 800 horse-power. The grade of half per cent. will demand another 800 H.P. Allowing a margin of 400, brings the power to 2,000, or greater than any existing electrical locomotive. The trouble with high speeds is not, however, altogether in the attaining of it but in the management of it when attained, its safe operation, the care of side tracks, junctions, &c.

The self-contained steam locomotive is a kind of wild beast free to move where it listeth. It may be utterly regardless of signals and rush into all kind of dangers, no one being able to do more than give a signal against it. An electric locomotive, on the other hand, cannot move if the operator at the power house wills otherwise. It is in his power not simply to command but to enforce obedience by cutting off the supply of power.

The steam engine also labours under the disadvantage of imperfect balance, but we cannot say we attach very much weight to this argument. The present half-balanced condition of steam locomotives is due simply to a blind adhesion to the arrangement of cranks at an angle of 90° in



Magnet for Lifting Purposes.—Fig. 2.

place of, say, three cranks, the central one pointing exactly opposite the two outer ones. For high speeds, which imply long runs without a stop, there is not that need of starting power at every position that there is in the engine of a stopping train. Nor is there much occasion to regard the excessive piston speed so much feared. Even the clumsy moving parts of American locomotives have not prevented high speeds. Wind or air resistance has been neglected and something of reduced resistance might be secured by suitable design. Assuming electrical motive power, what should be the current and voltage. Obviously electricity must be cheaper than steam or it will not be adopted. This demands, it is thought, that the line loss must be as low as 10 per cent., and on this basis the current for 2,000 H.P. must be 2,984 amperes at 500 volts. Such a current cannot be transmitted any considerable distance with only 50 volts of pressure loss, and it would fuse a 0000 B. & S. wire. But 10,000 volts is a perfectly feasible pressure, as is also an ampèreage of 149·2 at a line loss of 1,000 volts, and it is suggested that one solution of the question of high speed electrical traction undoubtedly lies in the direction of alternating currents and the perfection of the induction motor. An electrical line would, for high speed purposes be divided into blocks of such a length as to cover the distance run by a train without current in stopping of its own accord from a speed of 100 miles per hour. So divided up, there would always be a dead section between trains, and collisions would be impossible, and in times of special danger, any section of line could be deprived of motive power. Such an accident as that of Emu Plains, where the man who despatched a train wrongly, knew of the certainty of collision before his train was out of sight, might have been at least mitigated had the motive power been electricity, and in many cases where neither train was on a down grade, entirely prevented. This effective control over moving trains is one of the great arguments in favour of electricity. Nor is it impossible that means may be contrived whereby, when running down hill and out of electrical connection with the line, a driver could be made aware that he ought to stop. In the disaster referred to, two trains met, and one of them was running down hill by gravity, and it is in such cases as this that the shutting off of current would not operate to stop the train, except by some contrivance that would show the driver that such was the case, and this is clearly an easy matter to contrive.

THE DEFINITION OF LOW PRESSURE.

The Report of a Committee appointed by the Board of Trade to consider whether it is desirable that the limit of low pressure as defined by the Board of Trade Electric Lighting Regulations for the Protection of Public Safety should be altered, and to report to the Board of Trade, is as follows:—

To the Right Honourable C. T. Ritchie, M.P., President of the Board of Trade.

The Committee having duly considered the question referred to them, are of opinion:—

1. That it is expedient to alter the definition of pressure in the above-mentioned regulations as follows, viz.:—

First, omit the following words:—

"Pressure on any alternating current system being taken to be the equivalent of pressure on a continuous current system when it produces an equal heating effect if applied to the ends of a thin stretched wire or carbon filament."

Secondly, in place of paragraphs (*a*), (*b*) and (*c*), substitute the following, viz.:—

(*a*) Where the conditions of the supply are such that the pressure may at any time exceed 500 volts if continuous, or 250 volts if alternating, but cannot exceed 3,000 volts whether continuous or alternating, the supply shall be deemed a high pressure supply.

(*b*) To be worded as existing.

(*c*) Omitting "or the equivalent of 3,000 volts."

2. The Committee further advise that the following amendments should be made in the proposed regulations, viz.:—

(*a*) Regulation (1) to read as follows:—

"Save as hereinafter provided, the pressure of a supply delivered to any consumer shall not exceed 250 volts at any pair of terminals."

(*b*) Regulation (31) add—

"No such conductor shall be at a higher pressure than 300 volts from earth."

(*c*) Regulation (6) for supply omit the words, "or less than 45 volts, if continuous, or the equivalents thereof respectively, if alternating."

In place of "150 volts," read "250 volts."

Add at the end the following proviso, viz.:—

"Provided that no change shall be made in the pressure of the supply to any consumer in consequence of the issue of these regulations, except with his consent."

3. With reference to the suggested alteration to Regulation (31), for safety, the Committee are of opinion that to

enable the use of 500 volts continuous pressure between the outer conductors of a three or five-wire system with bare conductors, laid in conduits, the Board of Trade may give a provisional sanction to an earth connection being applied to one point of the middle conductor, in any case in which they are satisfied that a high insulation is maintained on all other points of the system, and that suitable and sufficient means are provided for the immediate detection, localisation, and correction of any fault of insulation.

4. The Committee consider that in making the above suggestions they have indicated clearly how, in their opinion, the question of limitation of pressure should be treated, to adequately secure the safety of the public, and to meet the requirements of electric lighting undertakers and the convenience of their customers.

They do not, however, wish to insist upon the exact wording suggested, and would leave the final drafting of these amendments, and any consequential verbal amendments of the draft regulations, in the hands of the Board of Trade.

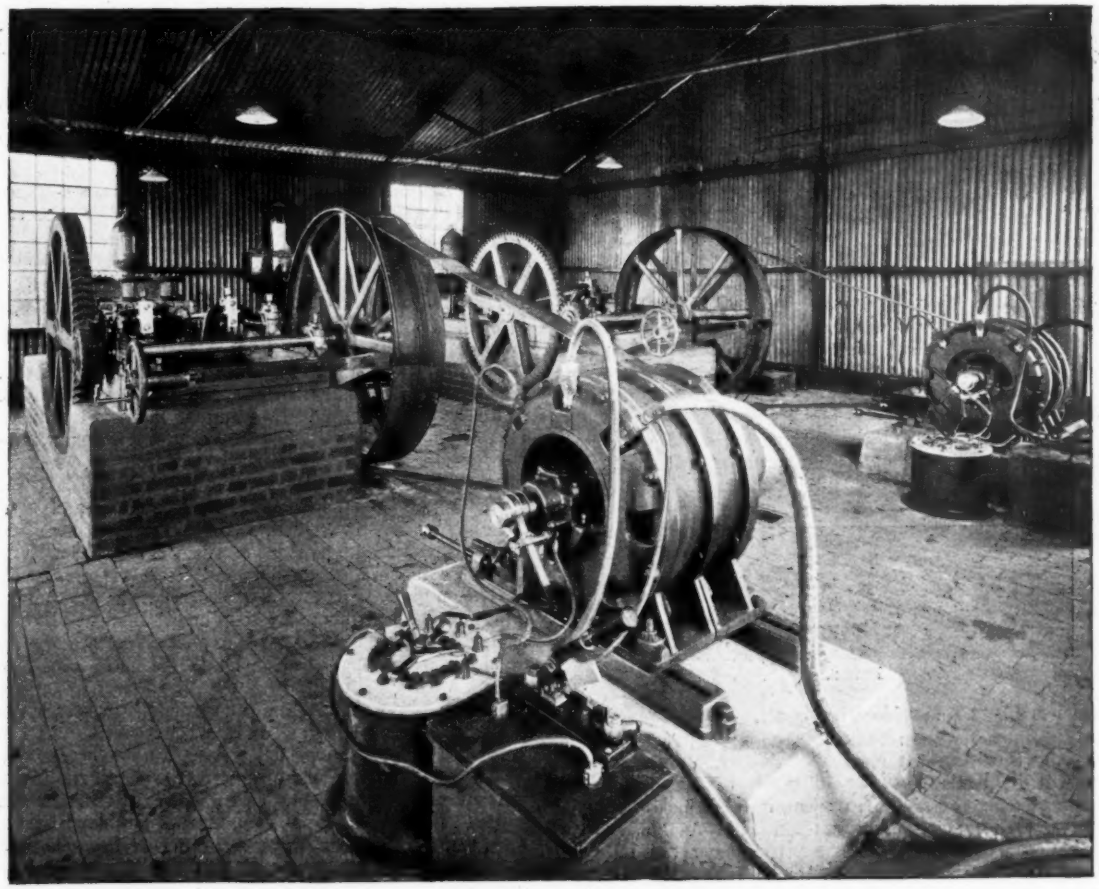
(Signed) Kelvin.
W. H. Preece.
P. Cardew.

8, Richmond Terrace, Whitehall,
December 2nd, 1895.

ALTERNATING MOTORS FOR PUMPING PURPOSES.

When the electricity works at Worcester were described in this Journal some months ago, it was mentioned that electricity was to be utilised at the Corporation Waterworks for the purpose of driving pumping machinery by means of alternating current motors. As these pumps were to be used throughout the day, it was thought they would materially help the day load of the station, especially as the turbines were designed to take up the whole of the light load. The waterworks are some distance from the electricity supply works, and special high tension mains have been carried there. The current is there transformed by means of two 30-kilowatt transformers to 100 volts, at which pressure the motors are arranged to work.

There are at present two 3-throw horizontal plunger pumps, with rams 6 inches diameter, and 15-inch stroke, each set being capable of pumping 10,000 gallons of water per hour against a vertical head of 300 feet, through 5,000 yards of 10-inch pipe, at a speed of about 45 revolutions per minute. Each set is fitted with a second motion shaft, spur wheel and pinion, and fast and loose pulleys with striking gear complete. The pumps are placed side by side upon a strong cast-iron bedplate of sufficient length to take the driving gear. Each pump is fitted with brass suction and delivery valves, and glands and stuffing boxes bushed with brass. The pump rams are of close grained cast-iron, turned and fitted with guide, shoes, and steel pins. The two motors which are employed are each capable of developing 30 brake horse-power, and are of the alternate non-synchronous type, running at about 500 revolutions per minute.



Alternating Motors for Pumps.

The motors, after being started and put to work, require very little attention; indeed, it is no uncommon thing for the pumping room to be left and locked up for a considerable time. We certainly know that on one occasion a friend called at the water works, and finding no one about, proceeded to the pumping room, which he found locked. Looking through the glass door, however, he could discern the motors working away merrily. Not very wonderful, perhaps, but sufficient to show that alternating current motors can, and are, doing work that requires considerable power.

This work was part of the contract carried out by the Brush Company for the Worcester Corporation.

ELECTRICAL COMMUNICATION BETWEEN MOVING TRAINS.

M. DE LA TOUCHE, the engineer of the Western Railway of France, has directed attention to the following means of securing communication between train and train as each pass on their journey, the object being to preserve a given and suitable space between those travelling on the same pair of rails. The rails are, in the first instance, electrically connected, so as to insure perfect electrical continuity, each rail, however, being maintained, as far as possible, insulated from the other. In order to effect this the rails are at their point of junction electrically bonded, or connected together. On each engine is arranged a small dynamo, A (fig. 1), driven from the axle of one pair of the wheels, as also a set of

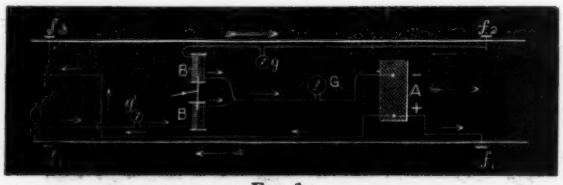


FIG. 1.

accumulators to provide the necessary current when the dynamo is still, or out of circuit. These cells, it is said, are of sufficient capacity to provide current for two hours, and the dynamo is of 2-horse-power. The connections are such that the dynamo, or the batteries, as the case may be, shall send a current to the rails by means of roller connections, f_1, f_2, f_3, f_4, attached to the front and rear of the locomotive. The current thus sent into the rail is employed to actuate certain apparatus in near trains, or, in conjunction with that from other near trains, the apparatus on the locomotive with which we are dealing.

This apparatus is termed the warning apparatus, and consists of two electro-magnets or coils, which, by the aid of levers, operate the whistle or automatic brake. Three gal-

FIG. 2.

vanometers (fig. 1), are placed in circuit. One, G, to indicate if the current is flowing; the others, g and g^1, to indicate to the driver if within the vicinity of danger. The arrangement will be made clear by reference to the diagrams. Fig. 2 represents two trains travelling in the same direction; fig. 3 two trains approaching one another. As the trains approach each other, so the current traversing the rails is augmented by the presence of the approaching train, thereby actuating the galvanometers, g, g^1, and indicating to the

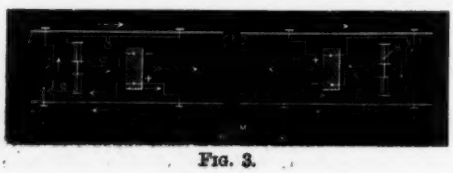


FIG. 3.

driver not only the direction in which the train is approaching, but the approximate distance it is off. It is said that a warning can thus be conveyed a distance of from 600 to 1,000 metres, and that the system is applicable to the operation of gates at level crossings, or signals. It is clear that such apparatus, placed on a locomotive engine, would be subject to very rough treatment, and we fear that the indications on the galvanometers would be liable to great fluctuations, due to the loss of current and variable connections. We are not aware that the system has yet been placed to any practical test.

We are indebted for the illustrations to our contemporary, *La vie Scientifique Revue Universelle.*

LOSSES IN THE OPERATION OF ELECTRIC RAILWAYS.*

By HERMANN S. HERING.

THE loss of a few per cent. upon small expenses or moderate capital may usually be neglected; but when losses occur very frequently, or are based upon large sums, they aggregate an amount that should be considered. A few of the losses which are not usually referred to, and still less frequently avoided, have been investigated by the writer in a preliminary way, with a view to determine their magnitude, and to examine them more thoroughly, if they are of sufficient importance. The losses to be discussed here are those due to defective roadway construction, to the manner of handling the controller, to stopping and starting, and to carrying additional dead weight on the car.

Roadway.—A straight, level, well-laid track, embodies the ideal conditions that should be approached as nearly as possible. All curves, grades and irregularities in the track, increase the watt-hours per car mile, and as this increase on a given track, represents a continual consumption of energy, it amounts to a large quantity in the aggregate.

The rails should be of the best kind, heavy, well laid on a firm foundation with perfect alignment. When the alignment is bad the friction is increased, and the see-sawing of the cars limits the speed, and is apt to make the trolley jump off.

The curves should be compound, and have as large a radius as possible, and ample pitch for high speed. The smaller the radius, the larger the amount of energy required to run the car over the curves; if the radius is very small, necessitating a slackening of the car speed on approaching the curves, the number of watt-hours required is still further increased by the loss of the car's kinetic energy, which must again be supplied to it in bringing the car up to speed. Double trucks have an advantage over single trucks, in that the friction is but slightly increased on curves, whereas the increase with single trucks is considerable.

The grades should be made uniform, and those of a short, "choppy" kind, be avoided, as they introduce irregularities, and the down grade portions of them are not usually made use of for drifting, being short and possibly steep. The gain in a down grade is mainly that it enables the car to drift, as otherwise the watt hours are still further increased by the car using power on the down grade as well as on the up grade, or else the brakes are down hard, and most of the car's potential energy is lost.

Large vertical curves should be placed between the grades in order to avoid sudden changes in the direction of the car's motion, which also frequently results in a loss of energy.

These requirements for proper roadway construction seem obvious and essential, but as so many of them are disregarded in important roads, even at this late day, it does not seem amiss to mention them again. One instance in mind is the case of a prominent road, which, at the top of an 8 per cent. grade, not only has a vertical curve of ridiculously small radius, but also a sharp reverse curve on this vertical curve. This is a most undesirable condition, and in this instance was totally unnecessary. The foot of this grade also has a very small vertical curve, necessitating a slow speed, where a high speed would result in a considerable saving. On a portion of this same road, presumably built for high speed, two sharp reverse curves occur for no apparent reason, thus causing not only a considerable decrease in speed, but a loss of energy as well.

Defective switches and special work also result in a continual loss of energy, as they require each car to slow up on every trip, which always results in a loss of energy unless the brakes are not used.

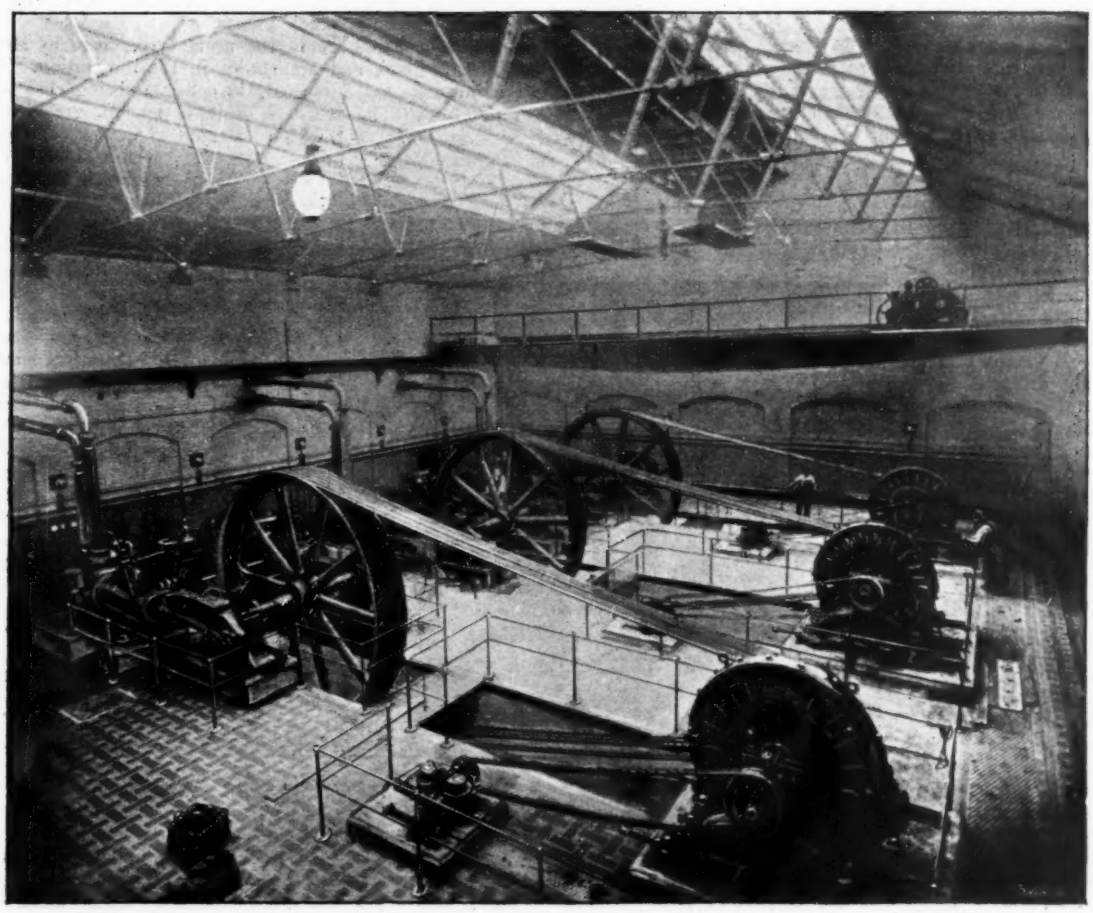
The fault lies partly in the fact that the civil engineering work of roadway construction is seldom designed and superintended by competent civil engineers. The managements of the companies, in a mistaken endeavour to economise, either employ inefficient engineers, or else require their electricians to add that to their already numerous duties, and very few electrical engineers have sufficient experience to attend to this feature of the work properly. It invariably

* New York *Electrical World.*

pays in important work to employ specialists, as there is enough in each branch of engineering to engross individual attention, and an attempt at a combination invariably results in a sacrifice in one or all. The old adage, "A jack of all trades is a master of none," applies directly to this "multi-phased" engineer. During the past few years, however, the roadway construction of electric railways in general has greatly improved, as experience has demonstrated the economy of first class work.

The advantage resulting from a removal of five turnouts, the alteration of some short grades, and the enlargement of some of the curves, was shown in a test made on a well built single track road, and repeated on the same road after a portion of it (68 per cent.) had been double tracked, and the alterations made. The road was suburban, and the track consisted of 54-pound T rails, laid on oak ties, and 8 inches of stone ballast. The car was operated by the same motor man in both cases, and was run at maximum speed. Owing to there being five turnouts less, and to the fact that most of the curves were reconstructed for high speed, the time of the trip was reduced, and consequently the speed increased 12½ per cent., while the average current was decreased 12 per cent. on the up grade trip, and 7 per cent. on the round trip. This difference is due to the roadway alone, as the other conditions were the same in both tests. The fewer number of turnouts, switches and sharp curves permitted more uniform speed. A much greater difference would have resulted had the road been poorly constructed in the first place.

Handling the Controller.—The manner in which the controller and brakes are handled by the motor man has a very important effect upon the consumption of energy by the car. By far the largest part of the electrical energy used by the cars is expended in accelerating and lifting them, the amount required for horizontal propulsion being comparatively small. In the suburbs, and sometimes in the city, the grades are the main consideration in the design of the electrical equipment of the roads. In city work, where stops are made at all, or nearly at all street crossings, the energy required by the car is mainly for the purpose of starting, as there is but little uniform speed. The energy used in starting and propelling it up grade is stored in the car as kinetic and potential energy, less the amount lost in the mechanism and in rolling friction, and can largely be made use of in propelling the car after the current is shut off, by allowing the car to "drift." For instance, a car and passengers, weighing 17,200 lbs., or 8·6 tons, and with a traction coefficient of 12 lbs. per ton, would require a horizontal draw-bar pull of 103 lbs. on the level. At a speed of 10 miles per hour, the kinetic energy would be 57,500 foot-pounds, which would enable the car to drift 560 feet, theoretically, and probably about 300 feet actually. The speed decreases nearly in proportion to the distance the car drifts.



Salford.—General View of Generating Station.

In going up a 3 per cent. grade for 500 feet, the potential energy stored in the car would be 258,000 foot-pounds. In going down the same grade, the force exerted on the car, which is the component of the weight along the grade, would be 516 lbs. Subtracting the friction, that is, the draw-bar pull on the level, 103 lbs., leaves 413 lbs. not required, which either produces acceleration, or is wasted in the brakes. The energy required to propel the car down this grade is the friction, 103 lbs. times 500 feet, or 51,500 foot-pounds, which, subtracted from 258,000, the potential energy at the top of the grade, leaves 206,500, which is a surplus, and is stored as kinetic energy in the car in reaching the foot of the grade, if no brakes are used. The velocity of the car at the foot of the grade would be 27·8 miles per hour, and with a friction of 103 lbs., the car would go about 2,000 feet on a level after reaching the bottom of the grade, due to its own momentum, assuming the friction to be constant. Actually,

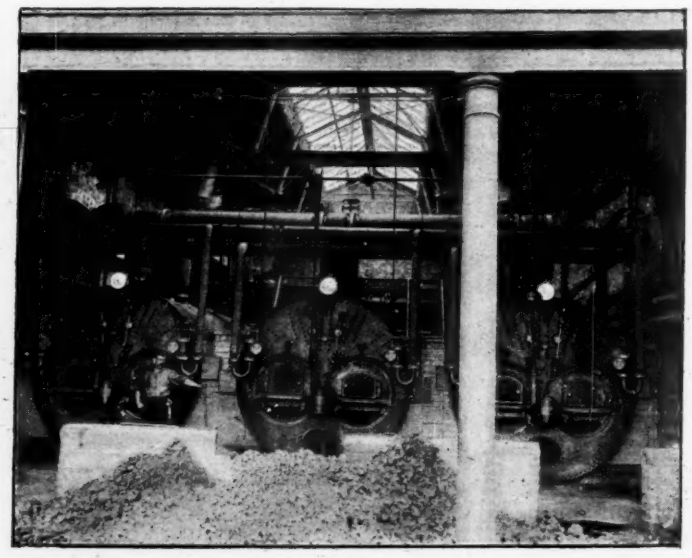
this would be much less, due to the wind resistance and the increased friction at higher speeds, &c.; but even at 50 per cent., that is, 1,000 feet, the distance would be three times the length of the up grade, or 1,500 feet from the top of the grade to the point where the car would stop. This shows the great amount of energy stored in the car in going up grade, which is mostly wasted by the brakes in slowing up and stopping on down grades. Although it is impossible, in many cases, to run under these ideal conditions, it is nevertheless important to construct the road with this question in mind, and also to avoid the use of brakes as much as practicable. Motor men frequently use current on a down grade, where it is totally unnecessary, and then jamb down their brakes when reaching the foot of the grade, which results in a total loss of this energy.

(*To be continued.*)

THE ELECTRIC LIGHTING OF SALFORD.

If we were to say that Salford is the worst district in Great Britain to be lighted by electricity, no doubt we should be severely criticised, especially by central station men whose lamp density, or the want of it, is one of the secret troubles of their lives. But a careful study of the district of Salford would convince one that if an electric supply succeeds there, it will be successful anywhere. It is evident that the district is more than usually difficult, because the uncommon pressure of 3,000 volts has been adopted for the mains.

The County Borough of Salford, which is the area over which the present system has powers of working, consists mostly of small dwellings, especially is this the case for some distance round the works, and it is not until the mains have gone three miles from the works that the residential district is reached.



Salford.—View of Boilers.

The system was originally designed for house transforming, and, though this may be to a slight extent departed from where there are clusters of consumers, house transforming will be mainly employed. While one must to some extent regret the introduction of 3,000 volts into buildings, we must confess that it was about the only system that could have been used with any hope of success. We are not sure whether small transformers, the primaries of which are wound for 3,000 volts, impose any difficulties in the way of an efficient supply, but it is obvious that there must be more difficulty in making them secure than those in which a lower pressure is employed. As far as we saw, the house transfomers are adequately protected, and can be easily disconnected from the mains for repairs and examination, and the fact that the Board of Trade have apparently raised no objections is sufficient testimony to the safety of the arrangement.

The system is controlled and owned by the Corporation of Salford, and commenced work in August last. At the present moment about £40,000 has been spent on completing the works, including additions and alterations, which were being made on the occasion of our visit some weeks ago.

The works are situated in Lower Broughton, a part of the Borough of Salford.

The system is a high pressure alternating current one, the pressure being 3,000 volts. We give two views of the interior of the works, one a general view of the dynamo room, and the other a view of the boilers.

There are three sets of combined plant, slow speed horizontal engines driving alternators by means of ropes. There are some interesting features about the engines, which have been made by Messrs. Browett, Lindley & Co., of Patricroft Works, Manchester. They are of 200 H.P. each, working at 160 lbs. pressure, and running at 85 revolutions per minute. The frames of these engines are of the Corliss type, and both high and low pressure cylinders are fitted with Corliss valve gear. The governors are of the improved "Porter" type, and are fitted with Higginson's mercury regulators; steam jacketting is employed on both cylinders. A rocking lever, driven from an extension of the piston rod of the low pressure cylinder, works the condenser, which is provided for each engine. The cylinders are 14 and 24-inch bore by 30-inch stroke. The engines are fitted with sight-feed lubricators to cylinders, and continuous lubrication to all the bearings.

The alternators are of the usual type, made by Messrs. Mather & Platt, and are shown in the illustration. They are unusually well protected, the collectors being enclosed in glass boxes. The bearings of these machines, which are large, are kept cool with a constant supply of cold water, which circulates underneath the bearings. They are lubricated with castor oil, which is forced in under considerable pressure. The exciters are fixed on a continuation of the alternator shaft.

The switchboard is of the Ferranti type, similar to those used at Portsmouth and other places. A very complete testing room is provided, provision being made for the adequate examination of meters and transformers. The steam raising plant has been supplied by Messrs. Tinkers, Limited, and consists of three Lancashire boilers, 30 feet long and 7 feet 6 inches in diameter. Each boiler is supplied with the usual fittings. The steam mains are duplicated throughout; they are of 10 inches diameter, and made of steel plates $\frac{3}{8}$ths inch thick, each length being fitted with cast-steel flanges, the welds of the lengths being still further strengthened by two wrought-iron rings on each. The whole of the boilers, steam pipes, &c., have been covered by Messrs. Leroy & Co., Manchester, with their improved patent non-conducting composition, which has, we understand, given satisfaction. There are the usual water catchers and separators. Three feed pumps of the three-throw type are driven by vertical steam engines; they are each capable of delivering 12,000 lbs. of water per hour. A fuel economiser, of Green's manufacture, is employed, which is made up of 192 pipes.

An interesting feature in the steam raising plant is that gas coke will be burnt; this is obtained from the Corporation gasworks; but seeing that the market price for coke in Salford is about 7s. or 8s. per ton, it is not likely to prove a surpassingly cheap fuel. The furnaces of the boilers are fitted with Henderson's patent movable fire-bars, which have been previously described in these pages. Half the fire bars, by means of suitable apparatus, are caused to move vertically, while the other half moves backwards and forwards. By this combined motion the clinkers are gradually carried to the rear

end of the furnaces. The bars of the three boilers are driven through the necessary gearing by a small high-pressure engine, which is adequately protected against dust.

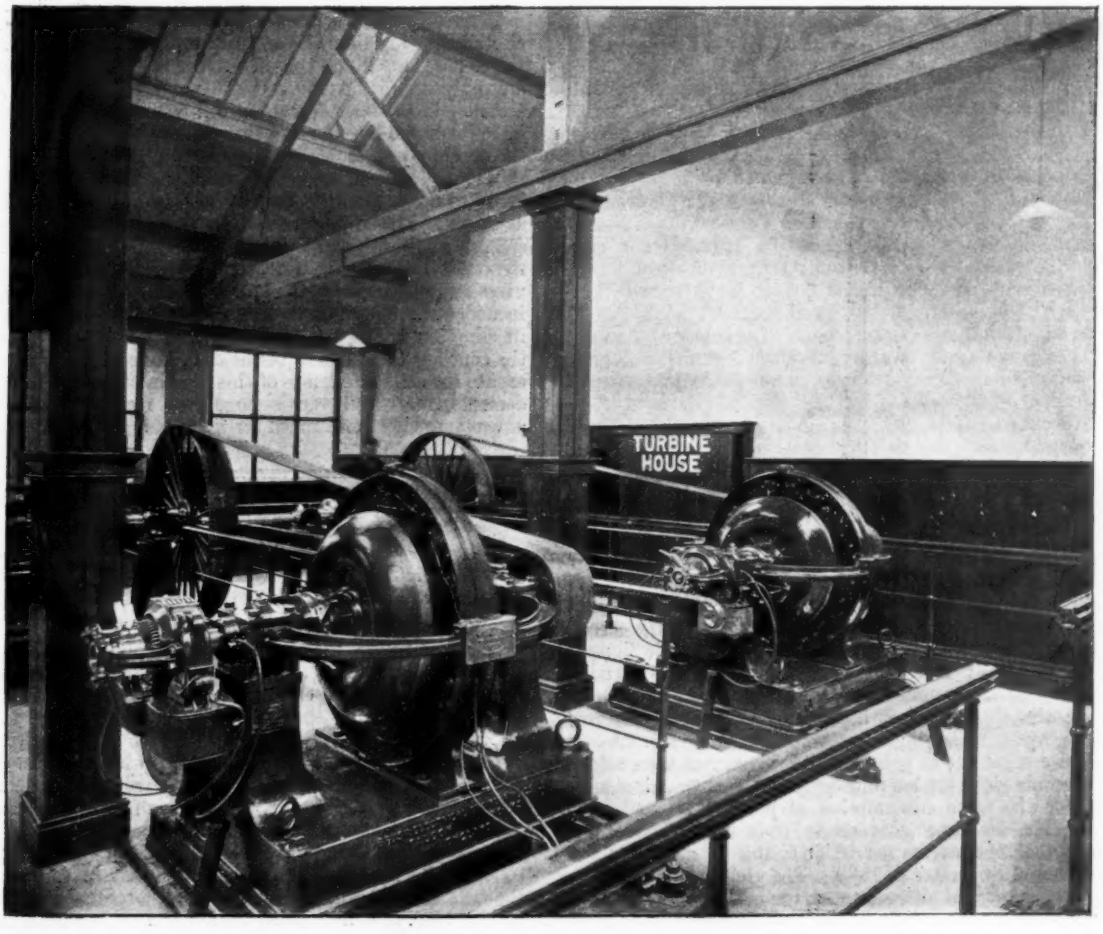
Concentric mains have been employed throughout the system, the Fowler Waring Cables Company and the British Insulated Wire Company having supplied them. As we have already mentioned, it is proposed to add to the system by providing one or two sub-transformer stations. Owing to the peculiar nature of the district, the progress in acquiring consumers has been somewhat slow. Salford people seem to be a bit frightened at the cost, but, no doubt, a little experience will dissipate many of these fears.

WINDERMERE CENTRAL STATION.

WATER-DRIVEN electrical plant is unfortunately very rare in this country. There are a few instances, it is true, but they are not on a large enough scale to merit much attention. The illogical reasoning of a preacher once led him to declare that large rivers generally flowed past large towns. Following a similar method of reasoning, we may say that waterfalls in this country shun large towns. When we consider, however, the very retiring and unassuming nature of most falls in this country, it is not surprising. Whether the use that is made of water-power at Worcester is likely to be copied in other places or not is not easy to say at the moment. The working costs at Worcester will determine to some extent that question. The Windermere station, which is an example of alternate current water-driven plant, has been in existence nearly two years, and has achieved considerable success. We have not previously said much about this station, so the accompanying illustration will be, no doubt, interesting. It is worth noting that though the station is a small one, it nevertheless succeeded in paying a dividend at the rate of 6 per cent. per annum during its first year.

The present generating plant includes two A7 Mordey-Victoria alternators, each developing 25 kilowatts. These are belted to countershafting which is coupled direct by means of a claw coupling at one end to a 40-horse turbine, manufactured by the well-known firm of Messrs. Gilkes and Company, Kendal, and working under a fall of 26 feet; while at the other end of the countershafting a horizontal steam engine, having a cylinder 9½ inches diameter and a 12-inch stroke, is also connected through a claw coupling and is capable of running up to 300 revolutions per minute. This engine is supplied with steam by a Galloway boiler.

Apart from the success of this station, the Windermere installation is of special interest from the fact that it is an example in this country of permanently lighting the streets and highways of a complete parish by means of incandescent lamps. It is also the first instance, apart from an experimental one, of the adoption of the Brush series incandescent street-lighting system by which ordinary 16-candle-power 100-volt lamps are arranged in groups of 20 in series across the constant-potential 2,000-volt mains.



WINDERMERE WATER-POWER STATION.

The post, as shown in our illustration, represents the general character of the fitting adopted, but in the Windermere case ornamental scrolls are added below the globe, and give a handsome appearance. The globe, which is clear on the bottom half and ground on the top half to act as a reflector, contains two lamps, one of which is a standby, and is automatically lighted the instant the first one fails, thus preventing an interruption of the whole group from the failure of one lamp.

The underground mains for the series lighting extend for a distance of over six miles.

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LONG BURNING ARC LAMPS.

Mr. Newton Harrison is the author of an article on the subject of 150-hour arc lamps in the columns of an American exchange, and in view of the introduction of the Jandus lamp into England, it is not without interest at the present time. The pressure required for lamps of this type, as given by Mr. Harrison, varies from 70 to 85 volts, so that only one can be used on 110-volt circuits in place of two ordinary arcs. Mr. Harrison makes mention of the fact that when the watts consumed in closed globe and ordinary arc lamps are, in either case, the same, it is necessary to consider the light obtained, the saving in carbon, and the value of an added convenience that includes all advantages, in order to draw a comparison.

The writer has evidently carefully noted the peculiarities of sealed globe arcs, for he draws special attention to the points in which observers on this side were particularly interested. When two ½-inch carbons are brought a short distance apart in a sealed globe, after the arc has been started, the crater that forms is of very sudden curvature, and causes a continuous spiral movement of the arc in its effort to find the point of lowest resistance. Flickering

Lamp Column used at Windermere.

results, re-adjustment is continually necessary, and the light given out is trifling, because of the nearness of the carbon surfaces. When separated to a greater distance, all signs of crater practically disappear, and the arc passes steadily between the carbon surfaces, wearing them both away, so as to give the appearance of flat faces. Of course, increased distance apart, means higher pressure, but a greater amount of light can get out in proportion to the current than before. An open air globe arc lamp, using ½-inch carbons, gives more light for the same consumption of power than the closed globe. Mr. Harrison goes on to state that, about 1882, Bidsley took out patents in relation to this form of lamp, and was followed by Baxter in 1883. The globe has not been so much the subject of discussion as the outlet or valve. The Howard globe, such as is now used, a small, cylindrical globe enclosing the carbon extremities, invites the claim that the gases within become luminous. The patent on the orifice or valve seems to be controlled by M. S. O'Kun, and it is curious that no mention is made of Jandus.

According to the authority from which we quote, the life of a lamp having ½-inch carbons, within voltage of 75 to 80, is about 120 hours' steady run. The manner in which this form of lighting may sooner or later cover some of the ground formerly occupied by incandescent lamps is very apparent in many cases.

The real question commercially at issue may be put in a nutshell. On one side we have a lamp which, for a given consumption of electrical energy, admittedly gives a lower candle-power per watt than the ordinary arc, but having the advantage of requiring little or no labour, and renewals of carbon only at long intervals. On the other hand, is an arc giving a higher candle-power per watt, with the disadvantages of daily renewals of carbon and the labour attached thereto. Too much importance is generally attached to this, and too little to the expenses of electrical supply, as will be clear from the following memorandum of cost of carbon and current in a 500-watt arc lamp, supplied to us by an authority who has had an experience second to none:—

1,000 feet carbon	£2	5	0
Labour trimming	4	0	0
The above is for 6,000 hours burning, and therefore 3,000 units of current are expended, which at 2d. per unit	25	0	0
But at the usual price to the consumer, the current, at 6d. per unit, will cost	75	0	0

It will be seen at a glance that the real cost comes in with the current supply, and we will now call attention to some data which appears in Mr. Harrison's article, apparently comparing sealed and open globe lamps. We say apparently, for there is nothing to show that the comparison is as we surmise, excepting the difference of voltage, Mr. Harrison explaining that all ordinary arc lamps require, as a rule, 50 volts.

Candle-power, 1,500. Carbons, ⅜th inch diameter.		Candle-power, 2,000. Carbons, ⅜th inch diameter.	
Volts	75	Volts	50
Ampères	5	Ampères	6

The sealed globe consumed 75 watts, or 25 per cent. more electrical energy than the ordinary arc, and gave 500 candle-power less, also 25 per cent. Assuming that these figures are only approximately correct—we do not credit their accuracy in the least degree—it will be clearly perceived that, light for light, the consumer would have to pay much more for his supply in the case of the closed globe type.

We, are inclined, however, to think that this form of lamp is not so much fitted to compete with ordinary arc lighting, as to make a position for itself in special places and under special conditions, and if it can be shown—and, we believe, figures will shortly be forthcoming on this point—that it gives more light per watt expended than high candle-power incandescent lamps, there seems to be no reason to preclude its adoption in all parts of the civilised world. If, however, the contrary turns out to be the case, there would be no valid excuse for using arc lamps of this type in preference to incandescents, for therein are secured even more than the very advantages that are claimed for the closed globe.

REVIEWS.

Mesures Electriques. Par Eric Gerard. Paris: Gauthier-Villars et Fils, 55, Quai des Grands-Augustins.

This book is a collection of a series of lectures delivered at the Montefiore Electrotechnical Institute of Liége. In the introduction the author very appropriately considers fully the question of errors of measurement and the conditions for obtaining the greatest probable accuracy; this is an important subject and one to which too little attention is generally paid. The approximations to which various kinds of measurement can be made are also stated. Valuable hints are given as to the proper way in which results should be tabulated, and, also, what observations should be included in the records. Geometrical and mechanical measurements follow in the next chapter. We notice that in speaking of the reflecting galvanometer, M. Gerard states that if a curved scale is used, the curve being the arc of a circle with a radius equal to the distance between the mirror and the scale, then the deflections in divisions will be *exactly* proportional to the current, in other words, that the equation $a = \frac{1}{2}$ arc tang. $\frac{\delta}{2}$ is an equation to a circle, a statement which is certainly not correct. In Chapter III., photometric measurements are dealt with. This is a subject which is still in an unsatisfactory condition, although it is gradually improving. Electrical standards are next considered, various forms of apparatus being described. In speaking of standards of capacity, M. Gerard mentions condensers made of paraffined paper (the exact type used by the Post Office for duplex working); as a matter of fact, it is not safe to use these condensers as standards, as they cannot be depended upon for the purpose. Mica is the only suitable dielectric which can be used. The general question of galvanometers is dealt with

at considerable length, very numerous types of the instrument being described and their theory gone into.

The chapter on the "Measurement of Resistances" is fairly full and up to date. In discussing that favourite subject, the Wheatstone Bridge, M. Gerard perpetuates that delusion that the greatest sensibility is obtained when all six resistances (the four arms and the battery and galvanometer resistances) are equal. As a matter of fact, the premises on which this theoretical conclusion is based are theoretically incorrect. The various methods of measuring electrical power are fully considered, and methods of measuring self-induction also receive a fair share of attention. The measurement of the resistance of electrolytes is briefly considered; measurements of this kind are extremely difficult to make accurately, and we have not found any of them to be really satisfactory. Indeed, so difficult is it to get really reliable results, as regards electrolytic measurements, that we look with very great suspicion upon all values which have hitherto been given as being correct. Taking the book altogether, it is a useful if not a particularly original one.

Recettes de L'Electricien. Par E. Hospitalier. Paris: G. Masson, 120, Boulevard Saint-Germain.

This is a decidedly useful work, though it may be questioned whether its title is not a little misleading. Undoubtedly, what are generally understood as "receipts," form a large portion of the book, but illustrations of insulators with short descriptions of the same, for example, can hardly, by any stretch of imagination, be held to come under the designation. It would be more difficult to say what the book does not contain than what it does, nearly every, if not every, branch of electrical science being touched upon. We notice that a satisfactory cement for ebonite is not given. We recollect in our youth being told (in all good faith) that an excellent receipt for this was to dissolve ebonite shavings in methylated spirit; we tried it and we believe have still the bottle containing the mixture (some 25 years old), but the ebonite has not dissolved yet.

First Stage Mechanics. By F. Rosenberg, M.A. London: University Correspondence Press, 13, Booksellers Row, Strand, W.C.

This work has been designed to cover the requirements of the Elementary Stage of the Science and Art Department in the theoretical mechanics of solids. The book is written in a colloquial style, and numerous illustrative examples are given throughout. Numerous "cautions" are also introduced in cases where the student is liable to fall into error. Altogether, the general style of the book is eminently calculated to teach in the clearest possible manner.

Kalender für Elektrotechniks (*The Electrotechnician's Almanac*). Edited by F. Uppenborn. Thirteenth volume, 1896. First part, with 194 figures in the text and three plates. Munich and Leipzig: R. Oldenbourg.

This new volume of the electrician's almanack is well abreast with the continued development of electrotechnics. Several parts have been re-written, including the photometric and mechanico-technical parts and the section on public lighting. The tables of curves for magnetising and the loss in the process have been drawn up anew with especial reference to German cast-iron. Some methods for detecting faults in cables carrying heavy currents have been newly elaborated, and will doubtless be welcome to electricians in charge of central stations.

The first part, which includes the mathematical, physical, and electrotechnical sections, as well as some matter of general utility, is bound up in the form of a pocket book. The second part, which is in the form of a pamphlet, treats of electrochemistry, including galvano-plastics, metallurgy, and the application of electricity in manufactures, in bleaching, and in the production of ozone. As supplement, follow legal determinations concerning steam boilers, patents, the regulations of the Imperial Institution for gauging and testing electrical measuring appliances, and lastly, the regulations for compensating workmen in case of accidents. These regulations seem in themselves fair enough, but the decisions of the German Courts savour, in many cases, of gross injustice. Thus in a case—not here reported—two workmen quarrelled and one of them thrust a rod or bar of red-hot iron into the body of the other. It will scarcely be credited that for this sudden outrage the firm employing the men was condemned in heavy damages!

Herr Uppenborn, by issuing this almanack, merits extremely well of the electrical profession.

Cavi Telegrafici Sottomarini. By Emanuele Jona. Ulrico Hoepli, Milano.

This is the first book on submarine telegraphy ever published in the Italian language. It is dedicated to Mr. G. B. Pirelli, the engineer who established the first factory in Italy for the construction of submarine cables, and in whose employment the author gained his experience of this branch of engineering. The date of publication is given as 1896, and we therefore set about reading the book confident of finding it, at least, up to date.

In the preface, the author makes mention of the various English authorities to whose writings he is naturally indebted for nearly the whole of the matter. So far as we are aware, he seems to have studied most of the literature which has ever been published on the subject, and is evidently a careful reader of English technical papers. Strange to say, however, no allusion is made to the papers read before the Institution of Civil Engineers by Window, Webb, Bright, Forde, and Preece.

A short introduction of some nine pages attempts to give a general idea of submarine telegraphy. Then follows a short historical part ending with a detailed description of the establishment of the factory at Spezzia in 1886, the building of the telegraph steamer *Città di Milano* in England, and the laying of several cables of a total length of some 1,130 N.M. for the Italian Government off the coast of Italy. In addition to these, Messrs. Pirelli & Co. have since laid 454 N.M. for the Spanish Government along the North Coast of Morocco and between Spain and the Balearic Isles.

It is worthy of note that this cable factory, established in Spezzia in 1886, under the patronage of the Italian Government, was the first attempt made to break through the monopoly which England had, before that date, held in manufacturing and laying all the submarine cables of the world. Mr. Jona could, therefore, have well afforded to mention that, at the outset, English engineers and English workmen were employed to initiate the Italians into the practical part of the work, without a knowledge of which all the literature ever written would have been useless.

This historical part is followed by a list of the submarine cables of the world taken from an Electrical Directory of 1894. Why not from the Berne list for 1895?

The manufacture of cables is dealt with in the second part of 33 pages, and useful illustrations are given of various machines. Figs. 38 and 39 are very good views of a sheathing, or closing, machine, and in fig. 44 is shown a section of the shore end of the Anglo-American Telegraph Company's last Atlantic.

The third part of the book opens with a chapter of the usual kind on the theory of the submersion of submarine cables, and goes on to describe the various telegraph ships in existence, giving plans of the *Città di Milano*. Fig. 50 is a capital illustration showing the interior of a cable tank with its crinoline fixed and a cable running out. The illustrations of the paying out gear, picking up gear, bow and stern sheaves of the *Città di Milano* are excellent. Not so, however, a drawing of the connections used between lengths of buoy and grapnel rope, which is not a bit like the real article and appears to have been copied from Mr. Wünschendorff's book.

The chapter on grapnels is a very complete one, and the illustrations are for the most part good. We should recommend, however, that fig. 74 be entirely suppressed as the "creeper" form of grapnel has for many years been obsolete. The toes of fig. 75 are not the right shape. The author has evidently gone into the matter very carefully, as he gives a list of all the grapnels that have ever been patented in England.

The chapter on sounding is a long one and is largely

culled from the paper on the subject by Mr. Stallibrass. The sounding machine shown in fig. 84 is a very good one, but it would have been well to have shown a more recent kind, such as that designed by Mr. F. Lucas and manufactured by the Telegraph Construction and Maintenance Company, or that in use at Silvertown, in both of which the wire is picked up direct on to the drum. The sinkers which are illustrated are very poor ones. Fig. 86 is the ordinary lead with an iron tube at the bottom, with which occasionally a sample of the bottom can be brought up. Fig. 88 is a weight hanging on a spring hook, which is supposed to release itself when the wire slacks on bottom being struck. As drawn here it certainly would not do so. Fig. 89 is a tube and detaching arrangement copied from Mr. Wünschendorff's book. It is one of the worst kinds and should be replaced as soon as possible by a later arrangement.

No mention is made of the Lucas snapper, which is a development of the old deep sea clamm invented by Sir James Ross in 1818, and which is certainly a useful instrument for shallow water and in cases in which the tube fails to bring up a sample, on stony bottoms, for instance. Indeed, we should say that the two instruments which are absolutely necessary to secure satisfactory specimens of the various bottoms are the snapper, and a tube of the kind which does not detach its weight on striking bottom, but only on the wire being hauled in from the ship. Neither of these are mentioned.

Considerable space is devoted to a description of the Siemens's bathometer. This should be cut out as the instrument proved to be of no practical value whatever. Two good illustrations are given showing the slipping of a final bight, and some admirable enlarged photographs of boring insects. A few pages are devoted to the repairing of cables. Among the illustrations is one showing the making fast of the drum ropes to the cable after the bight has been raised to the bow sheave. Another is a reproduction of a grappling chart, and we notice with pleasure that the drags are shown as they were made and not by perfectly straight lines.

The electrical part of the work is treated fairly fully in some 140 pages, and includes some of the very latest instruments, such as the Sullivan universal galvanometer and a combination testing key designed by Mr. Jona and his colleague, Mr. Pinelli.

The author would have done well to have given Price's key for carrying out the Thomson capacity test (null method). It is infinitely superior in practice to that given. He has also left out the "Bright" lightning guard, which is the only guard really suited at an out of the way hut for protecting the cable, being the only one which *automatically* places a fresh wire into circuit when one has been fused by a discharge.

At the end of the book are some useful tables, and a map, showing the submarine cables of the world, taken from a Berne publication, but which bears no date.

On the whole the book strikes us as being an excellent one, and Mr. Jona's countrymen should find it of the greatest value. We have looked it through with pleasure and we are glad to be able to say so.

The Physical Work of von Helmholtz. By Professor A. W. Rucker, F.R.S. Lecture delivered at the Royal Institution, March 8th, 1895.

Von Helmholtz has been described as the only man in the century who has achieved the unique distinction of occupying a foremost place in three different sciences, namely, physics, mathematics, and physiology. The career and work of such a man must be of especial interest, and Professor Rücker's Royal Institution lecture gives a very good idea in the short space available, of the nature of the important physical investigations carried out by von Helmholtz. Professor Rücker takes as a sample of von Helmholtz's work, his explanation of the physical difference between pairs of notes which we recognise as concords and discords, and discusses this somewhat complex subject pretty fully. What appears, however, to be the most interesting part of the lecture is the discussion of von Helmholtz's views on education.

"The watchword of Helmholtz in dealing with educational problems is *freedom*. Freedom for the student, freedom for the teacher. In England we are fond of insisting that there are certain things which everybody who aspires to academic rank must know; of hedging in our students by prescribed courses of study. We make them feel that general culture is an ironbound safe, which they must wrench open before they can attain the gem of real knowledge, rather than a setting without which the most profound acquirements seem unattractive and dull. Yet, von Helmholtz, one of the most highly educated men, one of the most comprehensive geniuses of the latter end of the century, will have no set courses, except as a preparation for a definite profession, is proud that Germany has retained the old conception of students as that of young men responsible to themselves, striving after science of their own free will, to whom it is left to arrange their own plan of studies as they think best."

These opinions must appear terrible heresies to our University authorities, but there can be little doubt that our present system fails to develop and utilise to the utmost the scientific genius of the country. To cram a youth to the utmost with other men's ideas in order to take a degree, and then turn him out into professional life where half his acquirements are useless, seems hardly to be the most efficient method of exploiting a man's natural abilities. We have little sympathy with a State aided institution for original research, we agree with Prof. Fitzgerald in thinking that that highest function of a scientific institution should be fulfilled chiefly by the Universities if they are to retain their proper position as the sources of the intellectual life of the country. How far they are from fulfilling this function may be guessed when we remember that the greatest discoverers in this country have been either private persons like Darwin, or professors at private institutions like Faraday. In Germany it is different, the Universities do the original research, and if we compare, for example, the magnificent Physical Institute of Berlin University, and the facilities given there for original work, with anything at our own Universities, the explanation of the difference in the results appears to be evident.

The Handling of Dangerous Goods. By J. Phillips. London: Crosby Lockwood & Son, 7, Stationers Hall Court, Ludgate Hill.

The title of this book hardly conveys a correct notion of its contents, as it contains a good deal more information than might be expected. Thus the commencement of the work deals with the composition, manufacture, nature, and uses of, various chemicals. A large amount of interesting information is given with reference to steel cylinders for oxygen gas, methods of testing the same and various experiments in connection with such testing being given. The composition and properties of explosives is fully gone into, and the methods of testing the same given. An account is given of accidents which have happened with various kinds of materials, and the causes which have brought about these accidents are explained. It would be difficult to give a full idea of the contents of the book without a lengthy exposition of it. It is full of useful and interesting matter, but we fear that its sale will be restricted within much narrower limits than it deserves, from its insufficiently comprehensive and explanatory title.

MECHANICAL TRACTION ON TRAMWAYS.

Our contemporary, *L'Eclairage Electrique*, has a very able article on this subject from the pen of M. Pellissier. The last meeting, at Bordeaux, of the "Association Français" saw the subject discussed in the Civil Engineering Section, all the points to be reviewed having been well set forth in a report by the Secretary of the Section, M. Guibert. Unfortunately, interested persons, inventors and constructors, did not answer to the call of the Association, perhaps because they were too selfish to do so, and one specialist alone attended, Mekarski, the inventor of the well-known system of compressed air used in Paris. Two memoirs were presented, one

by M. Denizel on the limiting gradients of tramways, and another by M. Francq, of fireless motor fame, used on the Paris—St Germain en Laye route.

The report of M. Guibert names, as the first question raised by mechanical traction, the car-kilometre cost, unhappily a question scarcely possible of being solved by a congress whose duty is rather to define the advantages, or otherwise, of each system of traction for different types of service. The capacity of vehicles, and their speed, are special questions to be examined. The tendency, natural with mechanical traction, is towards an increase of capacity of vehicle. Should this be encouraged, or, on the contrary, is it desirable to reduce capacity and increase the number of cars? Speed in a town varies from 8 to 12 kilometres, depending on the street traffic to some extent, but also, in a measure, upon public education. Having regard to traffic intensity, how high a speed can be had? Are safety appliances practicable, and is their use to be extended? Mechanical traction, adding to the weight of cars reacts on the permanent way, what are the best types of rails and supports, and what is to be said for electrically welding rails into continuity?

Dealing with the foregoing questions the first two are discussed simultaneously. The aim of all tramways is to carry as quickly as possible the greatest number of passengers in a given time, so as to give a maximum service, and realise the best return possible from the traffic. The first point is clearly the number of passengers to be carried, and it may be considered from a triple standpoint:—1. That of the passengers themselves; 2, of the tramway company; and, 3, of the public. For the passenger the ideal system is that which carries him at best speed and does not demand a long wait for a car. This demands a large number of cars following each other at short headway, and of capacity sufficient to find everyone a seat. The travelling sidewalk of the Chicago Exhibition was an example of this carried out at least so far as it demanded no wasted time in waiting. Applied to separate vehicles it leads to considerable expense on the part of the companies, and tends to an encumbrance of the streets incompatible with the rights of other users of the streets, as well as being non-remunerative, except under special circumstances, such as in Paris on the Boulevards, where cars of 50 seats follow at intervals of 2 minutes; in Broadway, New York, where 60-seat cars run every minute on the cable line, and in Chicago where cable trains of three or four cars of a total capacity of 150 to 200 places follow every 50 seconds. In Boston no fewer than 183 electric cars up and 197 down, pass the corner of Tremont and Boylston streets every hour. These seem pretty big figures, but may be, perhaps, compared with the omnibus traffic in London, which takes the place of the tramway traffic in other cities, London omnibuses running on many more routes and at times being practically a close procession, though each vehicle may have only about half the seat capacity of the Boston cars. These dense traffics are, however, exceptional, but generally traffic grows with the facilities accorded to it, and it is a fact that in America, lines built to assist the prosperity of towns, are now in brilliant circumstances. Thus in 1892, between Lynn and Boston, there was a car every hour, now they go every quarter of an hour. In 1892 they took 95 minutes, now they take 70 minutes, and people prefer the tram to the rail. From 10,000 fares in July, 1892, the traffic has grown to 103,594 in the same month of 1894, and the net result between 1891 and 1894 is that the net profit per car mile increased in the ratio $\frac{338}{173}$, while the car mileage was also more than doubled, and the profit per mile of line was also nearly doubled.

Profitable in certain cases, a service organised with cars of large capacity cannot always be profitably undertaken, because the traffic will not bear the consequent expenses. Expenses cannot be at all proportionately diminished by using smaller cars, nor can the wage account of the staff. The abolition of the conductor has been tried in America and in Chemnitz, and we might add in Sydney, N.S.W., where fifteen years ago a ticket system was tried with a glass fare box in the roof of the omnibus, into which passengers placed their tickets, subject to the gaze of all their fellow passengers.

In Chemnitz the economy is 55,000 francs annually, and as the fare is 12½ centimes, it follows that there must be 450,000 rogues avoiding payment before the economy is wiped out. The system seems satisfactory, but is not of universal applicability. Turning to the economy secured by reduced number of cars, this course reduces the coefficient of public satisfaction. Much depends on the length of journey. A passenger will wait 10 or 15 minutes if the journey is one of 10 kilometres or more, but, if by waiting he wastes more time than he feels it worth doing, he will walk, and on short routes cars must be frequent. At Nantes M. Mekarski has made experiments to determine to what extent it is worth while to shorten the headway. Along the quay line a successive augmentation of frequency from 10 to 5 minutes showed that 7½ minutes was the interval at which the number of passengers per vehicle was the greatest, but the experiment only lasted a few months, and is deemed insufficient to have taken count of the education of the public, and the question is complicated by such practical difficulties as the difference in the number of passengers at different hours, on different days, and during different seasons, a set of ideas on which our author dilates at some length, to the conclusion that mechanical traction lends itself particularly to such an irregular service by the facility offered for doubling or trebling traffic by means of the addition of a trailing car or cars. A double service of double cars thus quadruples the capacity. But for public satisfaction and to permit the normal development of the traffic, there should be nearly half the seating capacity unoccupied on ordinary service. An organisation based on a *régime* of "complet" is not desirable either for the public or the company. The *régime* of "complet" certainly does strike one as too common in Paris, and has given rise to the well known story of the American who avowed he had been to every place about Paris excepting Complet, and the 'busses to that place were always full. It follows that with a normal occupation of half the seats, the crush capacity of the line with double cars at half intervals may be seven or eight fold. Admitting the above basis of organisation, and given an occasional surplus of passengers, even then is it to be allowed to admit passengers in excess of seats? Our contemporary argues yes. With animal traction this is impossible. At least it ought to be; but we have ourselves seen probably 60 people in or on a Broadway horse car in New York, and a conductor gravely assured us he had often had 73 and once had had even 114, a figure we should not like to vouch for. But no objections on the score of weight can be urged against mechanical traction, and it is urged that the public will cheerfully submit to overcrowding as they do in Austria, Spain, or in Marseilles, and the author asks his brother Parisians if they would not also, did authorities permit it, take advantage of this on Sundays on the suburban trains.

Certain general rules may be laid down in respect of car capacity.

(*a*). For lines of heavy and regular traffic there should be large cars at short intervals.

(*b*). On sufficiently long lines it is, perhaps, beneficial to use large cars at small frequency.

(*c*). On short lines of thin traffic it is better to reduce the capacity of individual cars than to reduce their frequency, and this is only to be determined for each case on its merits.

(*d*). On lines of mean length an intermediate policy should obtain, and

(*e*). On lines of irregular traffic the motors of the cars and at the central station must be equal to the maximum demand.

In all cases, according to Francq, no cars should have a greater capacity than 50. Outside seats are deprecated, not but what they are very favourable, but, if adopted, should it not be according to season to satisfy the public who do not care to be stifled in summer? In Brussels and Lyons, to cite two cases only, each train has two cars, one open and one closed, and in fine weather the open car is full while the other is nearly empty.

So far, says our contemporary, "we have neglected the man in the street, an interest always difficult to measure. In his interest the number and speed of vehicles requires study. This we know is not done in America; there it is always the case of the public to be neglected, but they use a shorter word. Certain it is that the running of long and heavy cars, unable to deviate from a fixed line, is an inconvenience to other vehicles, though not much so in the fine wide streets of modern cities. In Paris, two cars coupled is tolerated, but not three, so one cannot say if this would prove inconvenient. In State Street, Chicago, where the traffic is

very considerable, though less so than in Paris, trains of three or four cars of 10 metres length each, run without inconvenience, and it is concluded that a frequent service may be permitted, even on a crowded street.

As to the interest of the passenger who finds the funds, this is clearly to travel at maximum speed. A speed of 14 k. may be right on one road and unsafe on another, but 20 or 25 k. may be safely run on little frequented roads, and it is no unusual sight in America to see cars shot along at 48 km. per hour. Generally, it is largely a question of experience on the part of the driver and of education on the part of the public.

As regards safety appliances, these are barely of an age to admit of any pronounced opinions upon them. There are many of these curious appliances. Municipalities have all approved of them who have investigated them. Persons laid on the lines have been picked up with not the least injury at speeds of 10 to 30 km., and, during trials, children would purposely put themselves in the way of a car to enjoy the fun of being picked up and no accident happened. At the same time, there is only one case known to our contemporary of the picking up of a person, other than one prepared for it, and instinctively choosing a suitable pose. This one case was a drunken person in Williamsport, Pa., who was picked up uninjured. The conclusion is that accidents are not much to be feared.

The track itself is an item of large importance and the cost of its repair and maintenance is dependent on the weight of the cars. A few figures are given of the weight per axle of four wheeled cars of different systems as follows:—

Cable	4½ tons per axle.
Trolley	5 " " "
Steam loco.	5 to 8 " " "
Accumulators	7½ " " "
Compressed air	9 " " "

The trolley thus comes out well and an electrically propelled vehicle is again superior to one steam or air propelled by reason of the perfect balance of the moving parts of the motor.

In America the prevalent rail is the girder of about 50 kg. per metre on cross-ties, the foundation rarely being concrete. These rails are not accepted in France because of the heavy resistance, and the favourite rails are the Broca or grooved rail known outside France as the Phœnix; and the Marsillon, a rail built up of two Vignoles rails, this latter, according to Mekarski, being preferable. With the grooved rail the wear on the surface finally brings the wheel flange upon the base of the groove with very increased resistance, while in the Marsillon rail the groove is always to be kept open to a given depth by a scraper, and, moreover, not only is the Marsillon rail able to serve several times, but costs less in the ratio of 120 francs per ton to 220 francs, though it is true that the Broca rail, by reason of its wide base can be placed directly upon its foundation, and this is a great economy in first cost of an otherwise expensive rail. The general equipment of rails, fish-plates, and the formation of road, are sufficiently important to demand separate treatment, and this we are promised in a future article.

THE THERMOPHONE.

During the recent session of the School of Engineering of the Massachusetts Institute of Technology, held at Keeseville, N.Y., U.S.A., a new instrument for measuring temperatures was described and exhibited. It is the joint invention of Henry E. Warren and George C. Whipple, and is evidently an electrical telethermometer of the resistance type. It is designed especially for obtaining the temperature of a distant or inaccessible place, but embodies a principle which may often be used to advantage in general scientific work entailing the determination of temperatures with greater accuracy than can be obtained with a mercurial thermometer.

The operation of the thermophone—for that is the name of the new instrument—is based upon the principle that the resistance which a conductor offers to the passage of an electric current depends upon its temperature, and advantage is taken of the fact that different metals have different electrical temperature coefficients. It is a curious fact that the coefficients of most "pure" metals are almost the same as that of copper, but that alloys have coefficients which are much lower, and advantage is taken of this in the thermophone.

The arrangement of the thermophone immediately suggests the Wheatstone Bridge, of which it is obviously a modification. Two coils of resistance wires, one of which is copper and the other is German silver, are made to form two arms of the bridge. These coils are joined together and placed at the point where the temperature reading is desired. They are drawn inside a long brass tube of small diameter coiled into a helix and hermetically sealed, the space between the wires and the walls of the tube being filled with oil to prevent corrosion and to hasten the transmission of heat between the outside of the tube and the resistance wires.

The sensitive coils are connected by leading wires to the ends of a circular slide wire, and at these points connection is also made with a battery. A third leading wire extends from the junction of the two coils to a movable contact on the slide wire. In this circuit there is interposed either a galvanometer or a telephone in connection with a current interrupter, the latter being operated by an independent battery connection. This combination of telephone and current interrupter is used in all the portable forms of the instrument, and has been found to be a very cheap and efficient substitute for a galvanometer. The presence of a current is indicated by a buzzing sound in the telephone; silence corresponds to the "zero deflection" of a galvanometer.

A little reflection will show at once that with the bridge balanced, there must be a different position of the contact for every degree of temperature. Hence a graduated scale can be constructed corresponding to the temperature of the sensitive coils. The slide wire is therefore wound around the periphery of a mahogany disc, above which is another disc, carrying a dial graduated in degrees of temperature. The movable contact which bears on the slide wire is attached to a radial arm placed directly under a hand on the dial, the two being moved together by turning an ebonite knob in the centre of the dial. This indicator is enclosed in a brass case attached to the box containing the battery, telephone, &c., and furnished on the outside with binding posts for the reception of the leading wires. The temperature of the slide wire and of the leading wires is practically without effect upon the readings.

The thermophone has already been usefully applied to the determination of temperatures at the bottom of a lake, of rooms situated at the top of high buildings, in researches on ventilation, &c., and since it will accurately determine temperatures up to 1,500°—2,000° Fahrenheit, it will doubtless find an extensive use in boilers, chimney flues, &c., especially since it is to be made self-recording.

The instrument is fully described, with diagrams, curves, &c., in *Science*, November 15th, 1895, pp. 639—643.

CORRESPONDENCE.

An Electrical Trades' Co-operative Society.

In the nature of things the prices obtainable for wiring work are not likely to rise, and, under proper conditions, it is to the interest of the trade that they should remain low; a less wealthy but much larger class of customer is tapped at present prices than at those of a year or two back.

It has become essential that wiring contractors should adopt all possible economies in the spending departments of their businesses, and I want to urge upon them the advantages of such a system of purchasing materials as is indicated in the heading to this letter.

Wiring contractors buy a large proportion of their supplies from one of the several middlemen so well known to the trade, because these middlemen can buy in larger quantities and stock and store better than individual tradesmen; but what individuals cannot do the trade as a whole could do even better than the middlemen, and cease to pay prices which enable the latter to keep up large establishments and pocket handsome profits.

I hasten to say that I individually have nothing to say against the middlemen as individuals, and do not forget their usefulness in the early days of few contractors and high-priced contracts; but times have changed, contractors have multiplied, prices fallen, and wages risen.

Let, then, the 30 odd wiring contractors of London, and the dozens of the provinces, combine to form a true co-operative society, to buy in huge quantities at bottom manufacturers' prices, and to retail to themselves at these prices plus the smallest practicable percentage to cover the cost of an economical management.

My co-contractors need not fear that in joining such an association they would sacrifice any hard-won special discounts. Large buyers would still buy cheaper than small ones by natural trade law, but both large and small would be relieved of the heavy cost of the middleman's establishment charges and profit. Neither would membership entail any loss of privacy, as there would be no occasion to reveal the destination of any material ordered.

As no advertisements would be needed, the heavy weekly cost of this now paid by self and friends indirectly in the middleman's prices, would be saved, and as the society would trade with members only, no costly rental for Queen Victoria Street, or other prominent premises, would be incurred; a few inexpensive, but accessible railway arches in a back street on the cheap side of the river, are all that would be required, coupled with a connection to the telephone exchange, and a rapid parcels delivery organisation.

If the society comprised the majority of the trade it would become the largest, and, perhaps, ultimately the sole, purchaser from the manufacturers with a significant further effect upon prices. No doubt, in time, the society would manufacture for itself, and thus eliminate other profits.

Many additional and most important results would follow the formation of such a society; but as these will naturally occur to your readers, I will only suggest one or two of the most vital:—

The prohibition, if desired, of contract cutting to a degree injurious to the trade as a whole.

The control of wages and enrolment and classification of workmen.

Co-operative accident and other insurance, &c.

Proper management of the society should obtain for members a certain position in the eyes of architects and consulting engineers, and authorities of every sort.

A set of wiring rules, drawn up by a committee of members, and formulated by the society, would be final.

As the society's business would be done on a strictly cash basis, but a small capital would be needed, and a very trifling contribution on the part of members would meet all requirements.

I hope you will allow full discussion of this suggestion, with a view to action.

Wiring Contractor.

High Voltage Glow Lamps.

In view of the fact that glow lamps for a pressure of 200 volts are now so much in vogue, a method which has occurred to me of affording mechanical support to the excessively long and slender filaments, necessitated by the higher voltage, may be of interest to some of your readers.

I should propose to wind the cotton filaments, when prepared for carbonisation, on cylindrical formers or cores, which should consist of some substance such as slate, marble, porcelain, or the like, capable of withstanding the high temperature of the carbonising furnace. These formers or cores would not be detached from the filament after carbonisation, but would be mounted permanently in the bulb, and thus effectively protect the filament.

It is hardly necessary to point out that a great length of filament might be wound on a comparatively short cylinder by placing the turns sufficiently close together. It might be advisable to cut a helical groove on the surface of the insulating core, so as to prevent any possibility of the adjacent convolutions accidentally coming into contact; but it is probable that the grip afforded by the contraction which takes place during carbonisation, would be quite sufficient to provide against this contingency.

It is quite possible that trouble might arise owing to the filament contracting to a greater extent than the cylinder, and thus causing the filament to part; but this difficulty could, I think, be obviated by choosing a substance whose coefficient of contraction during carbonisation should be such as to allow for the contraction of the filament; it is obvious that it need not have nearly so large a linear contraction as the filament, since a slight decrease in the diameter of the cylinder would mean a large increase in length of the circumference.

It would probably be an advantage to employ for the formation of the core some substance with a high reflecting surface, so as to lose as few light rays as possible by absorption.

T. J. Moffett, B.A., A.I.E.E.

A REMARKABLE EXAMPLE OF PREVISION.

Writing to the New York *Electrical Engineer*, S. Dana Greene says:—

We are apt to assume that in such an art as electricity the advances are rapid, and that the changes undergone from year to year are radical. It is true that the industrial development is great, but might it not be urged that in the great fundamental principles, the perception of them is early and thorough?

This has surely been the history of electric lighting, and the writer submits in parallel columns the conditions of the lighting art as applied to large cities in 1880 and 1895, as proof of the remarkable prevision exhibited by Mr. Edison 15 years ago, and of the remarkable adherence to-day to the principles he then laid down. It would seem that the period intervening has been occupied in filling up the programme thus laid down so long ago.

1880.	1895.
In 1880, Edison said that the successful electric lighting system of a large city must have the following essential features:—	In 1895, we see both in the United States and abroad:—
1. Engines and generators, *direct-connected*, in order to economise space and save losses in belting. Witness the "Jumbo" steam dynamos.	1. Standard practice of to-day. The Jumbos have been succeeded by vertical, triple, or quadruple condensing marine engines, with generator armature on each end of the shaft.
2. All conductors *underground*, to avoid troubles from the elements, contact with other wires, &c., and to forestall the day when cities would compel *all* wires to go underground.	2. Standard practice of to-day. The Edison tube system used in all of our large cities.
3. The *3-wire system* of distributing conductors to economise in cost of copper.	3. Standard practice of to-day. on alternating (secondary circuits) as well as direct-current circuits.
4. The use of a number of feeders, tapping a system of secondary mains at many points, in order to maintain constant pressure (maximum variation allowed, 2 per cent.) on mains.	4. Standard practice of to-day.
5. The *low tension, direct current* system, for all large cities where population is dense, on account of safety in handling circuits, and avoidance of electrical complications on same.	5. Standard practice of to-day.
6. The subdivision of light into small units, each unit operating in "multiple arc" with every other from the same system of mains.	6. Standard practice of to-day, both for incandescent and arc lamps.
7. The use *of a high resistance conductor* (or filament) enclosed in a *glass globe, highly exhausted*, as the only practicable form of incandescent lamp.	7. All incandescent lamps of to-day are made after Edison's original conception. The present Edison lamp has no equal.
8. The availability of secondary mains for attaching various forms of translating devices.	8. The uses to which the Edison low tension mains are put are being constantly extended for operating arc lights, motors, electroplating, electrolytic work, &c.
9. The development of a *complete line* of necessary wiring and *safety* devices, such as cut-outs, sockets, safety fuses, switches, &c.	9. While great improvements have been made in the *mechanical* details of these devices, the standard Edison devices and fittings of to-day are made under the *original patents*, and are the best in the world.

PROPOSED EXTENSIONS AT EDINBURGH.

Report by the Electric Lighting Committee as to Extending the Electric Lighting Plant.

Edinburgh, December 6th, 1895.—At a meeting of the Electric Lighting Committee, on motion by Councillor Mackenzie, as to what extensions should be made to the machinery and the mains of the electric light installation, there was submitted the following report by Prof. Kennedy:—

"14, Old Queen Street, Westminster, S.W.,
"*December 5th*, 1895.

"Edinburgh Corporation Electric Lighting.

"*Report to Electric Lighting Committee as to Progress of Work and Extension of Plant.*

"The Edinburgh Electric Light Station, as the Committee will remember, was supplied with plant sufficient for the supply of electric energy to 40,000 lamps wired. This was the number given in my preliminary report as likely to be reached within two or three years, for private consumers.

"I also gave, in my preliminary report, an estimate of works' costs as 3d. per unit (including all office expenses) when the output was 300,000 units per annum, and 2·5d. per unit when the output reached 680,000 units per annum.

"To a very great extent, in consequence (if I may be allowed to say so) of the energy and determination of the convener of the Committee, the number of lamps wired already, after only 7½ months' working, is equivalent to 42,300 of 8 candle-power, besides arc lamps equivalent to about 3,316 more, making in all the equivalent of about 45,600 lamps of 8 candle-power already connected up, as compared with my suggested number of 40,000 after four times as long a period.

"I am glad to say that not only has the success of the light been almost phenomenal in the matter of the number of consumers, but, under Mr. Monkhouse's management, the economy of production has also been very remarkable. The total number of units actually sold up to date has been about 285,000 (in 34 weeks), and the total station expenses, including office charges, have been about £1,850, or an average of 1·56d. per unit sold, including units for public lamps, and including carbons and lamp trimming. This result for little more than a first half-year's working, including all the summer months, when the demand is a minimum, and including also the actual start, when only 2,500 lamps were connected, is quite a record, so far as I know.

"It is easy now to estimate the results up to the end of the year (37 *weeks* from the opening of the station), and they will be approximately as follows:—

"Units sold, including arc lamps			384,000
"Total income	£7,750	or	4·85d. per unit.
"Station expenses	£2,200		1·37d. "
"Management and central expenses	575		0·36d. "
"Total working costs	£2,775		1·73d. "
"Interest and sinking fund at £7,670 per annum	5,457		3·41d. "
"Total costs	£8,232		5·14d. "

"Thus it appears that in your first 37 weeks' working you will not only have paid all working expenses, but very nearly also all charges for interest and sinking fund, in spite of the fact that the period covered has been mainly summer time. In your first completed year of working (*i.e.*, by the middle of April next) you will have sold over 800,000 units, your total income will have been about £16,000, and you will have a credit balance of between £2,000 and £3,000, after paying every charge of which I have knowledge, including interest and sinking fund at the rate mentioned above. The total working costs will have fallen to about 1½d. per unit sold, averaged since the opening of the station.

"The total capital expenditure, so far as it concerns matters covered by my estimates, has worked out a little less than the estimates. As you are aware, however, considerable additions have been made to the work, both in the station buildings and in the mains, which have caused additional expenditure. The result seems to me to have been the best possible justification of the policy adopted by the Town Council in making these extensions. The amount taken for interest and sinking fund is the amount fixed by the Town Clerk, and corresponds, of course, to the actual expenditure, and not to any hypothetical amounts.

"I have thought it well to place these figures fully before you, because there is no doubt that the question of extensions has at once to be faced.

"From Mr. Monkhouse's statements to me, and from my own observation of what has been going on in Edinburgh, I can hardly doubt that you must be prepared to supply current to an additional 40,000 or 50,000 lamps (beyond those at present connected) by next winter; this number at least, possibly more.

"In my original scheme for the station, I allowed for filling up the low tension side with units, each of 225 kilowatts, or about 400 I.H.P., similar to the two largest which are at present in place. I have gone into this whole question *de novo*, with the benefit of Mr. Monkhouse's experience in the actual running of the plant, but have come finally to the conclusion that I cannot improve on my original plan, and should recommend that it be adhered to. Under these circumstances, the smallest addition which would meet the case would be *four* more machines, each of 225 kilowatts. These together would provide for 26,400 lamps alight at once, or, say, 53,000 lamps wired beyond those at present on the circuit. The station could therefore safely supply current for 90,000 to 95,000 lamps wired, including the equivalent of the arc lamps. This number will, no doubt, be reached by the end of 1896, and I think the only question now is whether you should put down four or six new sets at once.

"This plant would, of course, provide for all required extension of arc lamps so far as they lie on the route of continuous current mains.

"On the high tension side of the station the addition of the 13 lamps from the post office to Regent Terrace (already sanctioned) will practically fully load the present rectifiers, leaving, of course, one spare machine. The proposed lamps in Clerk Street and in Leith Walk will be high tension lamps, and, if these are sanctioned, *two* more rectifiers will be required, because half the lamps must be on an all-night circuit and the remainder on a half-night circuit. These two rectifiers will be sufficient for 25 or 30 additional lamps for still further extensions.

"Four rectifiers, when fully loaded, constitute very nearly full load for one of the existing alternators, and will therefore take up all the balance of power at present available for private high tension lighting. For this purpose an additional machine will be required, and I think it ought to be of a capacity about double that of the present ones, or say, 160 kilowatts. It would therefore be able to supply both private and public lighting during heavy load, leaving the existing machines to come on late at night, when the private load ceases. At the same time I believe it would conduce to economical working if a motor-alternator were provided which could be driven by the battery in the daytime, so as to avoid the necessity of always keeping an engine (with boiler) actually at work.

"As to *buildings*, nothing has to be done in the *engine rooms* beyond finishing the concrete foundations for the new plant, as they were fully carried out in the first instance. The boiler house is also large enough for many more boilers than those mentioned below. But the space which must be occupied by the new boilers is used at present as coal store, and I think it would be desirable, when work is going on at any rate, to erect the gantry and finish the coal store above the boiler house, as I originally schemed it, and as, I believe, it is shown in Mr. Cooper's drawings.

"As to *boilers*, at present five out of the existing six boilers are used at full load, and the output at that time is more than can readily be done by *four* boilers, although the *five* boilers are by no means fully loaded. Four boilers more would therefore be sufficient to take up double the present output, but there would be a certain constructive convenience in adding five boilers rather than four, and I should advise that, if possible, this should be done.

"The present boilers and mechanical stokers have proved efficient and convenient, and I cannot suggest any improvement on the existing type, except in such matters of detail as can easily be included in a revised specification.

"As to *mains*, the existing feeders, which contain, of course, the heaviest copper, have been laid large enough for about 75 per cent. beyond their present load, so far as they are laid in armoured cable. Those portions of them which consist of bare strip, can be nearly doubled in section without moving the roadway or pavement, and at a very moderate cost. This addition ought, no doubt, to be carried out during the open weather next spring. Existing distributing mains do not require any change. The extension of either feeders or distributing mains to new districts (such as Stockbridge, Lauriston, or Dalry), is a matter to be considered and settled by the Committee, but does not press just now so much as the extension of plant, as, of course, no new roadwork can be entered on until the spring.

"There is another matter which I have to bring before the Committee, and which is of very considerable importance—it is a matter on which some decision should certainly be arrived at reasonably soon; I mean the question of the use of lamps of doubled voltage.

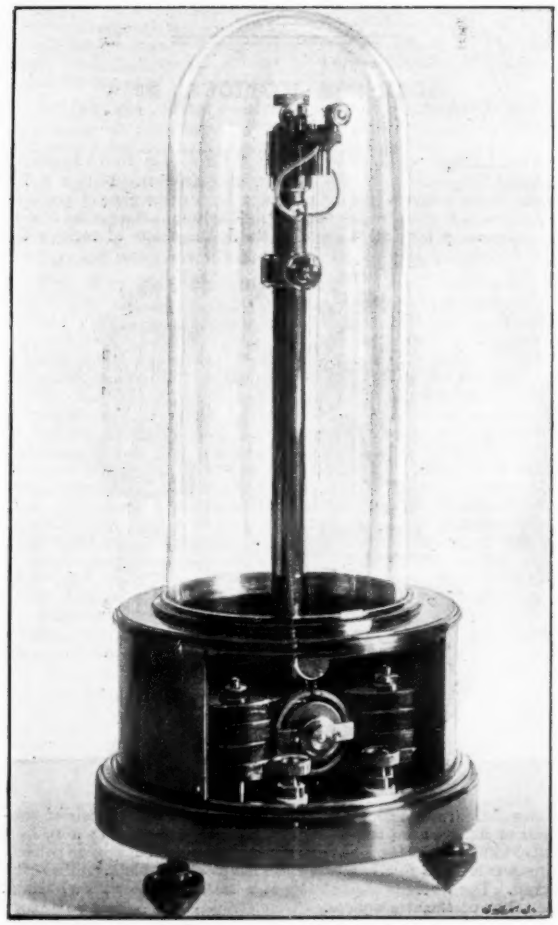
"Two years ago, when I was asked to advise the Town Council on the matter of electric lighting, it had only just become possible to buy lamps having a voltage of as much as 115, and I advised the use of a three-wire system with this, the highest voltage then practicable. It was certain that later on lamps would be manufactured suitable for working at a much higher pressure, but how soon this would come about was only a matter of speculation. The system, however, which I recommended to you, and which you have carried out, was chosen so that full advantage could be taken of the new lamps whenever they came on the market.

"They have come sooner than many of us expected, and are already to be had, of satisfactory quality, up to 200, and even 250 volts. I hope, therefore, that before long (that is, within the next two years or so), your system may be changed into a three-wire system, at just double its present voltage, a change which will *quadruple* the present carrying capacity of the mains, and which will involve very little change in the station plant, engines, and dynamos. (The capacity of the *plant* will not be increased, of course, but only that of the *mains*, as well as the distance to which continuous current can be supplied economically from the station by the existing mains.)

"There are only two points of difficulty about the matter, viz., the Board of Trade regulations and the disposal of the existing lamps. As to the former, the matter has been referred by Sir Courtenay Boyle to a small committee (consisting of Lord Kelvin, Mr. Preece, and Major Cardew), and their decision will very shortly be made public. The question of existing lamps is a more formidable one. After much consideration, I have come to the conclusion that the following plan, or something like it, should be adopted, and I hope to be able to carry it out even at Westminster, where we have about five times as many lamps to deal with as in Edinburgh. Let the undertakers give notice (*a*) that on and after a certain date (say February 1st, or perhaps May, 1896), their standard voltage will be 230 in respect to all consumers connected after that date; (*b*) that on and after another certain date (say August 1st, 1897) the new voltage

will be standard over their whole system, new and old; and (*c*) that at any time between those dates the undertakers will supply any existing consumers with new lamps (for 230 volts) at the price of 6d. each, the old lamps becoming the property of the undertakers. The effect of this last clause would be that each consumer would run his existing set of lamps as long as possible, and then buy a new set very cheaply from the undertakers. The undertakers would probably lose about 8d. per lamp on the transaction. Your number of lamps, equivalent to 40,000 of 8 candle-power, probably means 20,000 actual different lamps, and thus the total cost to you of an operation which quadrupled the capacity of mains which may have cost you £50,000 or £60,000, would be about £670, plus the wages of men employed in changing the lamps, &c.

"There are no electrical difficulties in the way of making the change, and for your public low tension arc lighting it would be an advantage; you would, in fact, get *nine* arcs worked for every *eight*, which you now have without any additional cost. There are some difficulties in detail as to shops which at present use not more than two arcs, and as to a few motors; but these are small matters, which can easily be arranged, and it is unnecessary to encumber this report with purely technical details.



"As to the cost of extensions, I stated to you in my report of April 8th, 1893, that the cost of doubling the capacity of your plant and feeders would not exceed £30,000. It is quite certain now that this figure will considerably more than cover the extension named, and will leave a substantial margin for extension of mains into districts not yet provided with electrical energy.

"One other matter I ought to mention—the question of the price per unit to be charged to consumers. Undoubtedly—as I have already pointed out in my early reports, and as is fully recognised by the committee—the way to make the electric light a success is to keep its price as low as possible. Although I am not to-day in a position to suggest a precise figure to you, I feel sure that you will be justified in making a substantial reduction either in the nominal price, or in the scale of discounts, to take effect after the New Year.

"(Signed) "Alexr. B. W. Kennedy."

The Committee, after careful consideration of the foregoing report, beg to recommend that four engines and dynamos (low tension), one engine and dynamo (high tension), two rectifiers, five boilers, and all necessary apparatus, be added to the existing plant. Should this recommendation be approved of, the Committee crave a remit with powers to carry out the work.

(Signed) A. D. Mackenzie, *Convener.*

CROMPTON IMPROVED BIFILAR D'ARSONVAL GALVANOMETER.

This instrument consists of a base which is heavily made of solid brass, insulated and levelled by means of ebonite headed screws; these heads having the section of an inverted pyramid with sharp steps, are easily wiped at any time, and afford, therefore, very high insulation. Magnets of the horseshoe type, in four sections, are clamped to the base by means of holding-down bolts, the poles being hollowed out to receive the coil, which is of the ring type.

A central pillow of hollow stiff section, and central with the axis of the base (into which it is screwed) carries:—1. A bifilar attachment in the form of two conical pins revolving in pillars (shown diametrically) placed upon an ebonite sleeve having a rim with a milled surface, and free to turn in a collar on a projecting arm cast upon the main sleeve which encircles the cap of the pillar round which it is free to revolve, being fixed in position by a set screw at the side. The cap is free to slide up and down in a vertical direction, and is controlled by the movement of the milled nut shown at top, and is prevented from turning by a set pin working in a slot in the pillar. 2. A bifilar adjustment. This consists of a thin slip of insulating material, fixed in a slot in the arm, and having a milled shoulder, and is attached to a collar or sleeve, free to move vertically or radially on the pillar and set screw shown at the side. When using the full sensibility of the instrument, this slip would lie parallel with the bifilar suspension; but by setting it at right angles with the same, by means of the milled shoulder, the period and sensibility may be altered at will by the position. 3. A core, and a clamping and damping device. These are secured to the pillar, and are free to move upon or round the latter by the collar shown, and are kept in position by a set screw. The core (an iron disc) is set in position on the arm by means of two nuts, one at the back and one in front. Outside the nuts are two light springs, tipped with rubber, and kept in position by the pins in the core; these clamp or limit the movement of the coil by means of the undercut washers and exterior nuts, so that violent torsion of the suspension and injury of the coil is avoided either when travelling or in use.

The coil is of the ring type, and is wound upon a wood former, which is subsequently removed. It is suspended by means of two metallic loops at the side to two hooks attached to the suspension to which the mirror is secured. The arrangement enables the removal and fixing of a new coil, or one of different turns or resistance, an extremely simple matter.

The terminals of the apparatus are insulated by collars and discs, and are connected by leads running up the centre of the pillars to bifilar attachments; the whole is protected from injury by a brass guard having a portion of its front cut away, a piece of the purest plate glass of thin section being inserted in the gap in order to obtain a well-defined image. A portion of the glass screen is, in some instances, cut away, and a disc of microscopic film glass about $\frac{1}{100}$th of an inch thick cemented over the opening. The whole is surmounted by a French glass shade, and is supplied with two coils, one of high and one of low resistance.

The maximum observed deflection obtainable with the instrument is 10 mm., with the scale at 2,000 cm. distance, and with the terminals connected to $\frac{1}{100}$th of an ohm in series with 20,000 ohms and a single accumulator, the difference of potential over the $\frac{1}{100}$th ohm corresponding, therefore, to one-millionth of a volt. The resistance of the coil is 1,500 ohms and its suspensions 40 ohms.

The greatest care has been taken to free the copper, silk, and other materials used from all magnetic particles. The importance of this has been pointed out by Professor Ayrton, and all makers of galvanometers of this type are indebted to him for calling attention to it.

LEGAL.

Sandon and Others *v.* The Chelsea Electricity Supply Company, Limited.

In the Chancery Division of the High Court of Justice on Friday, 6th inst., this matter came before Mr. Justice North.

Mr. Warmington, Q.C. (with whom was Mr. Badcock), said he moved on behalf of the plaintiffs for a sequestration for disobedience of an order or injunction which was made on June 25th last, by consent. The plaintiff, Mr. Sandon, was a leaseholder of a large block of buildings let out as residential flats, No. 21 (formerly No. 75), Cadogan Gardens, Chelsea. There were two other plaintiffs, tenants of Mr. Sandon. The defendants' works were erected before the plaintiff's house. Shortly after the erection by the plaintiff of his flats, complaints were made of the vibration and noise occasioned by the defendants' works in the plaintiff's flats, and a writ was issued on May 13th last, and a notice of motion for an interim injunction was then given. On May 24th an order was made that writ should be treated as a statement of claim, and the defendants were ordered to put in their defence within 14 days, leave being given to the plaintiffs to move to expedite the trial. The plaintiffs moved to expedite the trial, and on that occasion it was arranged that the motion should be treated as the trial of the action, and that the defendants should submit to the injunction in the order of June 21st, 1895. Side by side with the action in which he was moving, there was another action by the Rev. Montague Fowler, a tenant of the plaintiff's. Similar proceedings were taken in that action, and the same order made, and his learned friend, Mr. Swinfen Eady, was now moving for a similar motion to his. The order of June 14th was in these terms: "The defendants by their counsel consenting that this motion shall be treated as a motion for judgment, and consenting to this order, the Court doth order that the defendants, their servants, workmen and agents, be perpetually restrained on and after October 31st, 1895, from so working their engines, and so carrying on their works, Cadogan Gardens, Chelsea, as by reason of noise and vibration, or otherwise to interfere with the use and enjoyment of the residential flats at No. 75, Cadogan Gardens, by the occupiers thereof, and so as in any way to cause annoyance to the plaintiff, Robert Frederick Sandon, or to the plaintiffs, Sydney Thomas and Thomas Edmund Barker Thompson, as two of the tenants of the said flats." The plaintiffs had found that after October 31st, 1895, they were still suffering from this noise and vibration. The provisional order under which the plaintiffs were acting was without prejudice of the right of any person to proceed against them for nuisance.

Mr. Moulton, for the defendant company, said he did not suggest that his clients had a statutory right to make a nuisance. What he should say was that they had reduced the interference with the plaintiffs' property, in respect of which the injunction had been granted, to such a pitch, that it was no longer a substantial interference with the enjoyment of the property so as to be a nuisance; and secondly they (the defendants) had done all they could, and all it was reasonable to expect them to do in the period that had been allowed for the removal of the interference. The defendants had succeeded to a very great extent, and were still going on, because their intention was to do away with the whole of the interference.

Mr. Justice North: Your second point is that, although you have not completely removed the nuisance, you have done all you can do in the time, and if you have a little more time given, you will get rid of it altogether.

Mr. Moulton: Yes, of any nuisance that may remain. We have already spent £10,000 in changing the type of machines and in altering the building.

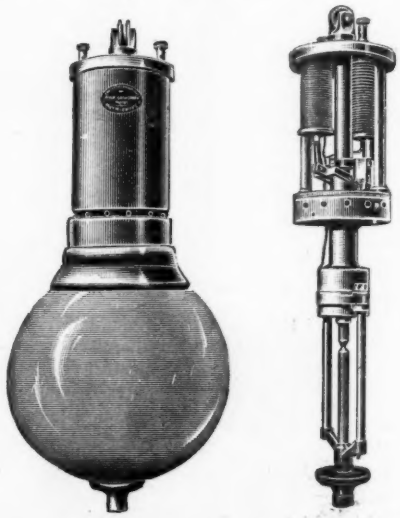
Affidavits were then read in support of the case for the plaintiffs, to the effect that the nuisance was practically as great as ever.

These were answered by the affidavits of Prof. Perry, Sir Fredk. Bramwell, Mr. Milne, and Mr. Frank King (the managing director of the defendant company), and others, to the effect shadowed forth in Mr. Moulton's statement of their case.

In the result, Mr. Justice North said that he was of opinion that there was still some nuisance, though he had no doubt that it had been considerably altered and remedied. The defendants had done a good deal of work which must necessarily have abated the nuisance. Of course, the injunction must ultimately be abated strictly, and, if defendants' works could not be carried on without a nuisance to the plaintiff, the defendants would have to close them altogether, whatever inconvenience and pecuniary loss it might be to them. But he was satisfied they would not have spent the large sums they had done without an expectation that the money would not be thrown away, but that they would, notwithstanding the injunction, be able to keep their works where they are. Various alterations had been made by the defendants, notably the reduction in the number of their engines and their removal to a place further from the plaintiff's premises, and he could not doubt that these alterations lessened the vibration if they did not remove it. Under these circumstances, he was satisfied that there had been a *bona fide* attempt to carry out the improvements necessary to comply with the order of the Court. The judgment that was made and consented to by the plaintiffs showed that a certain time was necessary, and no one had suggested that the Court should put its foot down and say that not a day or an hour should be given to the defendants to make the necessary alterations. He thought, therefore, the defendants should be allowed a further time to complete their improvements, and he should treat the motion of the one for an extension of time and extend the time for three months. Mr. Moulton had offered an undertaking that the defendants would complete their alterations as early as possible and would not work their steam engines after 10 p.m., and that he should accept, and order the defendants to pay the costs of the motion as between solicitor and client.

BUSINESS NOTICES, &c.

Arc Lamp.—The Richardson "I.R." arc lamp is being introduced by Mr. A. W. Richardson, of Patricroft. It is a differential direct-acting lamp, and claims to have a simple yet positive and sensitive feeding arrangement, which acts upon the carbon direct, thus dispensing with all complications in the shape of racks, rods,



chains, &c. This feeding arrangement is actuated by a pair of solenoids of a large area, the cores of which are attached to a rocking lever, which works the centre tube to which the feeding gear is fixed. This gear is fitted in a box below the lamp bottom plate, and so protected. The whole is constructed of a metal which will withstand the action of the atmosphere.

A Swiss Company.—The "Motor" Limited Liability Company for Applied Electricity has been formed at Baden, with a capital of 3,000,000 francs, 20 per cent. of which will be called up at first. The purpose of the company (which will be well supported by Messrs. Brown, Boveri & Co., of Baden) is to arrange at home and abroad all financial business connected with concessions, the building, working, acquisition, or supply of electricity or of electro-chemical operations, for the carrying out of which the co-operation of Messrs. Brown, Boveri & Co. has been secured. The circular which is being sent out to the above effect gives the autograph signatures of Walter Boveri, Max Huth, Fritz Funk, Dr. R. Spöndlin and Armin Kellersberger.

Bankruptcy Proceedings.—The statutory meeting of the creditors interested under the failure of Walter Raynes Smith, electrical engineer, to which we referred last week, was held on Friday last. The statement of affairs was given last week. Eventually the estate was left in the hands of the Official Receiver for summary administration.

In the *London Gazette* appears a notice of the release, dated October 30th, 1895, of Mr. John Bowling, trustee in the bankruptcy (1893) of Messrs. Austin & Myers.

Change of Address.—Messrs. J. H. Tucker & Co., electrical fittings and accessories manufacturers, of Birmingham, notify change of address from 10, Ryland Street, Birmingham, to Suffolk Works, Oozells Street, Birmingham.

English Engines in China.—The first of a set of three new pumps recently forwarded by Messrs. Hathorn, Davey & Co., Leeds, to the Chinese Engineering and Mining Company's works at Tongshan, was started on Monday morning, December 3rd, at their No. 2 shaft. The pump is of the latest type of Hathorn, Davey and Co.'s differential pumping engines, with a double-acting ram of 11 inches diameter and 4 feet stroke; it throws 475 gallons of water per minute from the bottom of the No. 2 shaft to the surface, a distance of 300 feet. The engines referred to consist of three compound surface-condensing differential underground pumping engines, having cylinders 18 inches by 30 inches in diameter by 4 feet stroke, each capable of raising 475 gallons per minute 300 feet vertically.

For Sale.—The Dewsbury Corporation is offering for sale electrical apparatus, including dynamo, gas engine, batteries, switchboard, &c. For further details see our advertisement supplement.

Price List.—Messrs. Glieme & Kügler, of Berlin, have sent us one of their price lists, showing a number of patterns of arc lamps.

Ready Reckoner.—A "Handy Ready Reckoner" for wages and casting purposes, from 1 to 300 hours, has been compiled and published by Mr. K. Openshaw, of Wyke Regis, Weymouth. The figures given are worked out upon a basis of a 54 hour week, and once the user understands the excellent and novel arrangement, it will be found easy to trace anything from 1 to 300 hours, up to 40s. per 54-hour week, but we think some further explanation of the system should accompany the book.

Smithfield Show.—Messrs. W. H. Willcox & Co. are exhibiting an assortment of their oils suitable for electric light installations, &c., including their special cylinder oil, dynamo castor, gas engine, and lard oil; also of leather belting. Also special sight-feed lubricators for engines, sight-feed lubricators for dynamos, automatic sight drop lubricators for engine cranks, copper oil cans, steel oil cans, Penberthy patent injectors, Willcox new semi-rotary patent pump, engine packings, engine wipers, waste, steam engine fittings and boiler mountings, asbestos and India-rubber goods.

The Day Gas Engines.—In a "Note" last week, we referred to the recent report on these engines by Messrs. Bramwell and Harris. The following are some further extracts from this report. Speaking of the design of the engines examined, it is stated:—"It appears to us that this design reduces to the greatest possible extent the number of working parts in a reciprocating engine. They are but three: the piston, the connecting rod, and the crank with its shaft and fly-wheel. There are not any slide valves, cams, or eccentrics, or other contrivances of that kind. There are no complex arrangements of passages, and it thus becomes possible to work these engines at a number of revolutions, and to work them with certainty as regards explosion taking place at the desired time, which, so far as we know, has not hitherto been attained in any gas engine. The question of the ability to make a large number of revolutions, coupled with the fact that there is a working impulse at each revolution, renders such engines peculiarly applicable for driving dynamos for electric lighting." . . . . "The Day gas engine seems to us to be singularly free from 'back' explosions. . . . . To summarise the results, we may say that, in an engine developing only 6·1 indicated horse-power, the gas consumption (London gas) on an extended trial was as low as 24·38 feet per indicated horse-power per hour."

ELECTRIC LIGHTING NOTES.

Aberystwyth.—The question as to the desirability and probable cost of lighting the Meat and General Market, the Town clock, and the Old Assembly Rooms, by means of electricity, is under consideration.

Aberdeen.—The Lighting Committee intends experimenting with overhead wires for electric street lighting in Broad and Bridge Streets.

Ayr.—On the 4th inst. the electric light was switched on to the Town Hall, Council Chamber, and adjacent rooms.

Brighton.—North Street was illuminated by electricity on Thursday night last week for the first time.

Belfast.—A member of the Harbour Board having asked a question as to the difference between the working expenses of the electric and gas lighting of the Queen's Quay, he received an answer to the following effect:—Gas for the nine months ended September 30th, 1893, £205 4s. 3d. Electric light for the nine months ended November 30th, 1895, £555 6s. 10d.

Brook Hospital.—With reference to the accepted tenders for the supply of plant and for wiring work at Brook Hospital (to which we referred a fortnight ago), it was mentioned at a meeting of the Metropolitan Asylums Board, on Saturday, that one of the unsuccessful firms had written to the Board, and the Brook Hospital Committee, complaining of the results of the tenders, that firm considering that the contract should have been awarded to it. The chairman said the tenders had been very carefully considered, and those which had been accepted had been decided by the unanimous vote of the Committee. There was no intention, the chairman concluded, of casting any reflection upon the ability of the firm in question; but, at the same time, the Committee considered that the tenders accepted were those which best answered their purpose.

Belfast.—The tenders of Messrs. J. H. Holmes & Co., and Messrs. Gill & Russell have been accepted for instruments and malleable iron pipes respectively. A short extension of mains to Messrs. Kirker, Sons & Co.'s premises has been ordered.

Carnarvon.—The vice-chairman of the Harbour Trust recommends the adoption of electricity for lighting the harbour, complaint having been made of a leakage in the gas mains. The surveyor is to consider the matter.

Cardiff.—The Local Government Board has sanctioned the borrowing of £12,500 for electric lighting extensions. The Great Western Railway Company asked the Council upon what terms it would undertake the lighting of the new passenger and goods stations with electricity. Mr. Harpur was instructed to ascertain what amount of electrical energy would be required. The chairman of the Lighting Committee stated that the revenue from electric lighting during the quarter ending September last was £671. In the quarter ending December 31st, he estimated it would be over £1,800. This showed that the energy was being sought after, and they had applications coming in that they were not really able at the present moment to supply. Mr. Harpur added that since the beginning of November they had had applications for 943 lamps, which they had been obliged to refuse for the time being. Mr. Morgan Morgan proposed the following resolution:—"That, in order to save all expense possible in the extensions of the electric lighting buildings and plant, this committee having confidence in the ability of the borough engineer, with the assistance of Mr. Appleby, to carry out such extensions, the borough engineer is instructed to prepare the necessary plans, specifications, and particulars, and obtain tenders for the several parts of the plant and works forthwith, and that the whole of the extensions be entrusted to him to superintend and carry out to completion." This was seconded by Alderman Jacobs, and carried. A further resolution was also agreed to, empowering the sub-committee to accept the necessary tenders and carry out the work in all its details.

Crosby.—Plans have been submitted to the District Council by the Liverpool District Electric Lighting Company, who have given notice of their intention to apply for a provisional order for the electric lighting of the district. The matter stands referred to the surveyor for report.

Devonport.—The County Council was to consider yesterday the advisability of applying for a provisional order for electric lighting.

Dundee.—Messrs. Urquhart & Small have offered to advise the Harbour Trustees, if the electric lighting scheme is proceeded with.

Three tenders were submitted for the electric lighting of Lochee Free Library and Public Baths. They have been remitted to the Lord Provost and the architect. The Council proposed to spend £200 on the work.

Messrs. Murdoch & Co. have applied for a supply of current for a motor in Tindal's Wynd.

The electricity rental for seven months ended in November was £1,325 2s. 7d., an advance of £330 15s. 7d.

Ealing.—The Surveyor reports that there are now 6,234 8-C.P. lamps applied for, 4,273 of which had been connected. The Council has appointed Mr. Knight (now at Messrs. Siemens Bros. and Co.) as chief electrical engineer at a salary of £240 per annum, increasing to £300. There were 45 applications for the post.

Edinburgh.—The Electric Light Committee has recommended the Council to adopt the report (published in another column), of Prof. Kennedy regarding the proposal for an extension of the electric lighting system. It is proposed to double the producing power of the plant and considerably extend the mains. Proposals for lighting by electricity the following thoroughfares have been referred to a sub-committee:—From Leith to Pilrig, southward to Salisbury Place, Fountainbridge; from Regent Terrace to Abbeyhill, along Lauriston to Tollcross, and Dalry Road.

Fareham.—The District Council, on 6th inst., considered the action to be taken consequent upon the verdict in the action brought by the Fareham Electric Lighting Company against the Council for damages. The proceedings were of an exciting character. The chairman moved: "That before deciding to pay the damages, or to accept the offer made by the company in open Court to purchase the undertaking at the amount awarded, the Council do lay the matter before the ratepayers, and that a poll of the parish for and against the purchase be taken." A member suggested that the Board at once resign and place itself in the hands of the ratepayers. The chairman's proposal, however, was carried, and the poll (by ballot) will be taken on Saturday, the 21st inst., between the hours of 8 a.m. and 8 p.m.

Germany.—It has been decided to largely extend the central station at Cassel, as also to establish a new one in the centre of the town. A Königsberg firm has submitted plans for a proposed central station at Ragnit.

Hampton Wick.—The question of electric *v.* incandescent gas lighting for lighting the streets has been adjourned for three months by the District Council.

Hammersmith.—An expert is to be engaged by the Vestry to report *re* electric lighting schemes and tenders, and advise generally *re* electric lighting, at not more than 200 guineas.

Hanley.—3d. per unit is to be charged for current for motive-power purposes.

Harrow.—The secretary of the Harrow Electric Light and Power Company, Limited, writing in reference to our Note last week, says that the Harrow Council sold their provisional order some time ago, and the Harrow Electric Light and Power Company, Limited, to whom it was transferred, was registered on July 5th, and is about to sign a contract with Messrs. Crompton & Co. for a complete station.

Harrogate.—A Local Government Board inquiry is to be held here on 17th inst. regarding application to borrow £27,000 for electric lighting, and other sums for other purposes.

Islington.—At the last Vestry meeting it was stated that the contractors for the engines and boilers had definitely promised that the machinery at the central station should be running by December 31st, after which the official test will take place, and supply be available by the end of January.

Ipswich.—The intended application of the County of London and Brush Company for a provisional order was the subject of discussion at last week's Town Council meeting. Ultimately it was decided to appoint a committee to consider what would be the most advisable course to pursue in the electric lighting of Ipswich.

Monmouth.—The Local Government Board has consented to the Council spending £20,000 upon the electric lighting and drainage scheme, and asked the new Council to reaffirm by resolution their former application for a loan. This was done, there only being four votes against the scheme.

Oldham.—The salary of Mr. Newington, the resident electrical engineer, is to be increased from £160 to £200 per annum.

Peterborough.—It is stated that the proposed installation of electricity by the Town Council is meeting with considerable opposition from some members of the Corporation "owing to the report of the borough engineer to the effect that the scheme would scarcely pay its way at the outset."

Pitlochry.—About four years ago Prof. Forbes devised a scheme for lighting Pitlochry with electricity, the motive power to be derived from the Falls of Tummel. At that time no further steps could be taken, as the proprietor of Faskally, being under age, could give no title to the water. Mr. A. E. Butter, of Faskally, has, however, now agreed to have details of the proposal worked out, with the view of ascertaining whether the electric light could be supplied at a reasonable cost. Prof. Forbes has been communicated with, and it is expected that a definite scheme will shortly be arranged.

Queenstown.—The Town Commissioners, on 9th inst., decided to memorialise the Board of Trade for a provisional electric lighting order.

South Africa.—The *British and South African Export Gazette* says:—We learn that Messrs. Siemens & Halske, Berlin and Johannesburg, have secured the order for the installation of the electric light into the dynamite factory at Zuurfontein. The installation will be of the three-phase system for 547 incandescent and 46 arc lamps. It is, we believe, the first three-phase current which has been fitted up in South Africa.—The manager of the Johannesburg lighting department has recommended the Sanitary Board to order 400 oak cross arms for the electric main poles, at an imported cost of about £200, and 20 small transformers of about 2, 4, and 6 H.P., at an estimated cost of about £340.—The Pigg's Peak Company, Swaziland, has placed the order for transmitting 100 H.P. with Mr. J. H. Davies, Johannesburg. The power will be generated by multi-phase generators at the falls, which are situated some six miles from the battery site. The lighting of the property will be carried out from the same alternating current.—Mr. J. Hubert Davies, electrical engineer, Johannesburg, has obtained an order for an electrically-driven hoist for hauling from the vertical shaft on the Ivy Company's property. He has also lately supplied a 45 H.P. motor to this mine for driving the battery, crushers, and Scoular tables; and another of 25 H.P. to the Argus Company for driving the battery.—The Horsham Company has placed orders with Mr. J. Hubert Davies, Johannesburg, for generating machinery for power and lighting, with a 50 H.P. motor for driving the pumps, and a 40 H.P. motor for the cyanide works. Mr. Davies is also supplying the following:—Vogelstrius Estate and Gold Mining Company, power and lighting machinery, including motors for driving the pumps for cyanide works, workshops, hauling gear, and also two 12 × 15 inches three-throw pumps; Witwatersrand Company, dynamos and motors for power and lighting, including motor for cyanide works, and three electrically-driven pumps; two similar plants to the Wolhuter and Crœsus Companies; to the Treasury Company, electrical pumps and cyanide motors; to the Simmer and Jack Company, an electrical depositing plant; to the Van Ryn Company, power and lighting plant, including motors for driving the large dam pump, the mine pump, crushers, and workshop machinery; to the New Kleinfontein Company, two 12 × 15 inches horizontal three-throw pumps, and all the necessary generators and motors for driving the same; and to the New Heidelberg Roodepoort Company, electric lighting and power machinery, including motors for cyanide works, workshops, and pumps.—We understand that the steam power for driving the pumps on the Princess mine will shortly be replaced by electricity.—An electrical plant is to be ordered for hauling purposes on the Langlaagte United mine.—An electric pumping plant has, we learn, been obtained from England for the Nigel mine.

Stafford.—It has been decided to have two arc lamps erected in the Market Square.

Stapleton.—The District Council has decided to oppose the application of the Great Western Electric Light and Power Company, Limited, for a provisional order. The Electric Lighting Committee is also to institute inquiries to see whether the now wasted power that originally worked three mills on the river Froom, could not be concentrated at one point for providing power for lighting the districts electrically.

Stockton.—The Town Council has appointed a committee to confer and visit other towns with respect to the provision of an electric lighting installation for the borough.

Southport.—The Electric Lighting Committee proposes to increase the lighting area by including Eastbank, London, and Nevill Streets. The matter is in abeyance, however, until the chairman of the committee was able to give the Council a detailed statement as to the financial position of the committee, and the result of the first year's working of the electric lighting system.

Swansea.—The tenders for the Swansea electric lighting scheme were all received on Friday, and will be considered at the meeting of the Electric Lighting Committee.

The Great Eastern Railway and Electric Lighting.—At a meeting of preference stockholders of the Great Eastern Railway, held on Tuesday at the Cannon Street Hotel, Lord Claud J. Hamilton said the directors had to ask for a vote of £200,000, including £20,000, for electric lighting. He stated that from time to time they had been lighting up all the first-class carriages and many of the third with gas as they came in for repairs. The proposed expenditure on electric lighting would enable goods and other traffic to be worked much more expeditiously by night. In answer to a question from Mr. Custon, the chairman stated that the board had carefully considered the question of electric lighting as against gas in the carriages, but they found that the expense would be far too great for them to attempt to undertake it. The electric light was particularly difficult to work in the case of trains constantly being severed in the course of their journey, and, besides, the consensus of opinion of the great railway companies at the present time was in favour of gas rather than electric light.

Torquay.—The Town Council discussed the electric lighting question last Saturday. The site which was proposed by Mr. Trentham for the central station seems likely to be abandoned, five owners of property in the vicinity having stated their intention to claim compensation if it is erected there. The whole question was subsequently referred back to the Electric Lighting Committee to consider further the questions of cost, suitable site, to canvass the town so as to ascertain the probable number of consumers, and to consult another expert.

Weybridge.—The Weybridge Electric Supply Company offered to transfer its provisional order to the District Council upon the payment of £100 to them before December 15th. At last week's Council meeting the matter was discussed, and the committee which had had the matter in hand was asked to continue negotiations with the company. The matter is, therefore, still in abeyance.

Wells.—The Electric Light Committee has asked the Town Council to empower the Electric Light Committee to select a site for a central station, to instruct the surveyor to prepare plans for the buildings, and to instruct Dr. Hopkinson to prepare necessary specifications upon which to advertise for tenders for the work, in order that it may be completed before June 24th next, when the gas contract expires. The Council, however, decided, by the casting vote of the chairman, to offer £14,000 to the gas company for its undertaking; therefore, the matter remains in abeyance for a few days.

York.—Prof. Kennedy has accepted the terms of appointment as consulting engineer to the Corporation, and will shortly make a survey of the city for the purposes of his report.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Coventry Electric Tramways.—The Coventry electric tramways were inspected by Major Cardew on Friday, November 29th.

Dublin Electric Tramways.—On Monday afternoon the Commissioners and officers of the Rathmines Township availed themselves of Mr. Clifton Robinson's invitation, and inspected the power-house at Ballsbridge, after which they took a trip to Kingstown on one of the company's new electric motor cars. In addition to Mr. Robinson, Mr. Fraser, the company's engineer, and Messrs. Little and Towle (representing the British Thomson-Houston Company, Limited), were in attendance during the inspection.

At the meeting of the Dublin Trades Council the same night, several matters having been discussed, Mr. J. Clifton Robinson and Mr. S. G. Fraser, C.E., attended as a deputation from the Southern Districts Tramway Company, and explained at some length the scheme for constructing an electric tramway system in the city. Several delegates having put questions to the deputation, a resolution was proposed supporting the project, but owing to the late hour, the motion was postponed until Wednesday.

Electricity for Dock Pumping.—Electrical power is being applied on a considerable scale in connection with the new floating pontoon dock, which is at present in construction for Smith's Dock Company, North Shields. This dock, when completed, will be one of the largest floating pontoon docks in existence. Eight 18-inch centrifugal pumps will be employed for raising the dock, each pump being driven direct by a separate 60-brake H.P. electromotor. Each of the eight motors will be fixed vertically over its particular pump, and will be direct coupled to the latter by means of a vertical shaft, both motors and pumps having vertical spindles. Ball bearings will be employed to support the weight of the revolving parts. It being necessary for the proper working of the dock to have the pumps under very complete control, the switches and regulating gear will be arranged together, so as to be under the control of one individual. The necessary supply of electrical energy will be obtained from a pair of direct coupled plants of inverted double cylinder combined engines and shunt-wound dynamos, capable, together, of giving about 570 electrical H.P. when running at a speed of 350 revolutions per minute. The plant has been designed to raise about 8,000 tons of water through the necessary mean head of about 18 feet, this being the maximum requirements when the dock is fully loaded with a large vessel, in about half an hour. It is believed that no other floating dock in existence can approach this in points of scale and rapidity. The distance between the generating plant and the dock will be about 200 yards, and the electricity will be transmitted at 500 volts pressure. As the dynamos are guaranteed to have a commercial efficiency of 95 per cent., and the motors an efficiency of 90 per cent., while the loss in the cables will be under 4 per cent, the total efficiency of transmission will be high. Further, there will be the advantage that the steam for working the engines will be obtained from existing boilers which do other work, it being obvious that the cost of fuel for boilers devoted exclusively to pumping would be very great, owing to the pumping being done only intermittently with intervals of rest long in comparison with the time actually employed in pumping. The system will probably be eventually extended to an existing graving dock, and another existing floating dock. The engines are being manufactured by Messrs. Belliss, the dynamos by Messrs. Crompton, while Messrs. Ernest Scott & Mountain are supplying the motors, and Messrs. Gwynne the pumps. The whole scheme owes its inception to Mr. Eustace Smith, managing director of the Dock Company, and has been arranged by Mr. A. A. C. Swinton, the consulting electrical engineer, to whose specification the plant is being made.

Electric Traction in Switzerland.—A concession has been granted for an electric tramway between Zurich, Oerlikon, and Seebach.

Electric Traction in Belgium.—The local railways in the Centre district belonging to the Société Nationale des Chemins de Fer Viceriaux are about to be converted into electric lines, the contract for the work having just been given to the Société Electricité et Hydraulique, of Charleroi.

Electric Traction in France.—A concession has just been granted for the establishment and operation of six lines of electric tramways in the town of Laval (Mayenne). A company has just been formed at St. Romain-de-Colbosc (Seine Inférieure) to establish and operate an electric tramway between the town and the railway station.

Electric Traction in Spain.—A 60 years' concession has lately been granted to a company for the construction and operation of an electric tramway between Cadiz and San Fernando-Chulara. Work on the establishment of the line has just been commenced.

Electric Traction in Austria and Hungary.—A concession has been granted for an electric local railway between Trieste and Opcina. Plans are being prepared for an electric mountain railway between Golling and Steg.

Electric Traction in Germany.—A proposal, which was recently submitted to the municipal authorities of Flensburg for the conversion of the tramways in the town into electric lines, has been rejected. The municipal authorities of Darmstadt have decided upon the construction of an electric tramway in the town.

Halifax Proposed Tramways.—The Halifax and District Tramways Company has deposited with the clerk of the District Council plans and other particulars of its proposed tramway scheme. Mr. F. Spencer, M.I.E.E., writes to the *Halifax Guardian*, saying that having had over 11 years' practical experience of electric traction, he is convinced that Halifax cannot do better than adopt the overhead electric system.

Horseless Carriages.—A meeting was held on Tuesday afternoon in the Cannon Street Hotel, for the purpose of considering the advisability of forming an association to deal with the subject of self-propelled vehicles. Sir David Salomons presided, and there was a crowded attendance. The chairman, at the outset, observed that they were anxious to remove from the Statute Books of the country what was a slur and a shame in the eyes of other nations. What they wanted was to create a new industry, and to confer benefit on the agricultural classes and struggling professional men. They required, first, to obtain an Act of Parliament to use "self-propelled" carriages, and should see that the Act conferred upon their carriages as much freedom as horses enjoyed at the present time, and they must not allow of any absurd taxes being placed upon them. He had no doubt that the result would be to find work for a large number of skilled artizans; they would not drive out of employment any workmen. In his opinion, when they were permitted to manufacture horseless carriages, they would soon give labour to more than all engaged at the present time in the cycling and carriage making industries. He moved, in conclusion, that it was desirable to form an association, to be incorporated under the Companies' Acts. Mr. Cumming Macdona, M.P., seconded the resolution, and said they were all extremely indebted to Sir David Salomons for the spirited way in which he had brought that important matter before the public. He (the speaker) had been over to Paris, and found that there were there nine large manufactories of these carriages in full work. It seemed strange that in a great country like ours we should be behindhand in so important a matter, particularly in these days of competition. The carriages had been tested over here, and it only rested with Parliament next Session to remove that most obnoxious Act which prevented our having the same facilities as those enjoyed by France, Germany, and America in regard to locomotion. Several other specches were made in support of the scheme. The resolution urging the formation of an association for the purposes mentioned was carried amidst loud cheers, and subsequently Sir David Salomons was elected president of the organisation. A council was also appointed, and other formalities having been carried out, it was decided to send a deputation to wait upon the President of the Local Government Board in support of the objects of the newly-formed society.

Mechanical Tramcar Motors.—A sub-committee of the Tramways Committee, which has been considering the question of mechanical motors for tramcar propulsion, is of opinion that it is desirable that some form of mechanical motor should be tried on one of the tramway routes, provided the committee, on inquiry, are satisfied that such motor would be more efficient and economical than the present mode of haulage. With that object, they recommended that an exhaustive inquiry should be made as to the various motors in actual work under conditions similar to those of the route proposed to be experimented on, and that the remit to them should be extended accordingly, with power to call in such technical assistance as they may consider necessary. The Town Council has adopted this recommendation.

The Gale.—On Saturday last the wind was so exceedingly boisterous at Blackpool, that one of the electric tramcars was blown off the rails, and was only pulled up with difficulty after travelling some distance in an oblique direction.

South Staffordshire Tramways.—At Walsall Town Council meeting on Monday, the Electric Construction Company, Limited, wrote that they had given notice to the South Staffordshire Tramway Company that they could not continue to run the electric portion of the latter company's lines on the present terms beyond the end of the month, when the existing arrangement would terminate. The reason given for this notice was that the road bed of the line was in a bad condition. The communication was referred to the Streets Committee.

TELEGRAPH AND TELEPHONE NOTES.

Atlantic Repairs.—The *François Arago* is fitting out for the repair of the Brest-St. Pierre Atlantic cable belonging to the Compagnie Française des Câbles Télégraphiques. It will be remembered that the company chartered the *Faraday* late in the summer, at a price, it is said, of £300 a day, and that though she succeeded in repairing one break in 2,500 fathoms, she left another untouched in some 1,700 fathoms. The *François Arago*, on her way, is to repair the Brest-Penzance cable belonging to the same company. This shallow water repair is not likely to detain the *François Arago* beyond the first couple of days of fine weather; but with the deep water repair it is quite another matter. While one cannot but admire the pluck which has prompted the despatch of the expedition in almost mid-winter, one cannot help thinking it would have been prudent to postpone it till the spring. If the *François Arago* succeeds in doing any good during the next three months, she may well be proud of it.

Cable Communication with Iceland.—The *Morning* says the Iceland Althing has requested the King of Denmark to communicate with other nations in regard to laying a cable from Iceland to the Continent. The resolution calls special attention to the importance of such a cable in the interests of meteorology. Had we telegraphic communication with Iceland, we might expect greater precision in the daily weather forecasts, and the time may come when we shall have a meteorological station in the Atlantic, midway between these isles and America, for, as every one knows, we get most of our storms from this latter quarter.

The Amazon Cable Expedition.—It is stated that the British Museum authorities have availed themselves of the offer of Mr. Alexander Siemens to allow representatives to go out with the cable steamer *Faraday* (which was to start on Tuesday last), which is to lay the Amazon cable. The gentlemen in question will go purely for the purpose of conducting a series of investigations into the natural history of the Amazon Basin.

The Pacific Cable.—A *Times* telegram says that the representatives of New South Wales, Victoria, and Queensland, assembled in Sydney, have decided to appoint delegates to the Pacific Cable Conference, probably the Hon. Duncan Gillies and Sir Saul Samuel. New Zealand was not represented at the meeting, but expressed her assent. It is expected that South Australia and Western Australia will acquiesce.

The Reduction of Telegraph Rates to India and the East.—We learn that a representative committee has been formed in connection with the third Congress of Chambers of Commerce of the Empire. We understand that the reduction of the present high rates for telegrams to India and the East will, with other subjects, occupy

the attention of this Congress. That there is undoubtedly room for amendment here is very apparent. A telegram can be sent from London to the frontier of Persia, over some 1,800 or 1,900 miles of aerial and submarine lines, for the sum of 5d. per word; but to reach India some 2,200 miles more of landline and cable (about half of each) have to be passed over, and the charge per word in this case is 4s. from London to India! When we call to mind the fact that the length of the sub-marine cables (Direct United States Company) between England and New York is over 3,000 miles (or, including landlines to London, say, 3,400 miles), and that the cost of a telegram between these points is 1s. per word, the possibility of a large reduction in the rate to India becomes at once evident. To make another comparison, let us take the case of a telegram from London to Vancouver, which has to pass over about 2,500 miles of submarine cable and some 3,000 miles of land line; a total mileage much greater than that between London and India. Here we find that the cost is only 1s. 6d. per word as opposed to the 4s. rate over the lesser mileage between London and India. In view of this state of affairs, it is instructive to find that the dividend paid by the Indo-European Telegraph Company has been 10 per cent. annually since 1885, in which year the amount was 12 per cent. We have not here taken into account the large reserve fund put to one side.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—January 15th, 1896. The Belgian Minister of War is inviting tenders for the contract for an installation of electric lighting in the new military school in the Avenue de la Renaissance in Brussels. Tenders to the Ministère de la Guerre, Brussels.

Brazil.—January 25th, 1896. The Minister of Industry of the State of Pernambuco is inviting schemes for the electric lighting of the town of Recife in that State.

Brussels.—December 18th. Tenders are invited for the supply of 11,692 telegraph poles. Tenders to the Direction Générale des Postes et Telegraphes, Brussels.

Cleator Moor (Cumberland).—Tenders are at present being invited for an electric light installation for central stores of the Cleaton Moor Co-operative Society, Limited. Particulars from the secretary, Co-operative Society, Limited, Cleaton Moor, Cumberland.

Durban, Natal.—December 28th. The Corporation invites tenders for the supply, from competent firms, for delivery and fixing at Durban, of steam and electrical plant for the lighting of the borough by electricity. The work will be executed under the direction of Mr. Fletcher, the borough engineer, and Mr. Hadfield, the electrical engineer, at Durban. The plant required includes high-speed engines, dynamos, cables, arc and other lamps, accumulators, &c.

Germany.—December 16th. Tenders are being invited by the Prussian State Railway Telegraph authorities at Saarbrücken for the supply of 28 normal sets of Morse telegraph apparatus. Tenders to be directed to the Eisenbahn Telegrapheninspection, Saarbrücken, Germany.

Leyton.—December 17th. The District Council invites tenders for electric lighting works, as follows:—Contract No. 1, Central Station buildings; Contract No. 3, gas engines, travelling cranes, piping, &c.; Contract No. 4, dynamos, switchboards, &c.; Contract No. 5, storage batteries; Contract No. 6, five miles of mains, including laying. Specifications, &c., can be obtained at the offices of Prof. Henry Robinson, C.E., 13, Victoria Street, Westminster, on payment of 5s. for each specification, &c.

Manchester.—December 20th. The Markets Committee invite tenders for the supply and erection complete of the wiring, accumulators, columns, and lamps, for lighting the Foreign Animal's Wharf, Mode Wheel. Particulars to be obtained at the city surveyor's office, Town Hall, Manchester, on deposit of one guinea.

Roumania.—January 15th. The municipal authorities of Ploesci, Roumania, are inviting tenders for the concession for lighting 46 of the principal streets of the town by electricity. Tenders to be sent to La Mairie, a Ploesci, Roumania.

Russia.—The Mayor of Charkow is prepared to receive tenders for the supply of steam and electrical engines for lighting, as well as apparatus and essential parts, necessary for an installation of electric lighting of 6,000 glow lamps and 500 arc lamps. Illustrated catalogues and price lists, with lowest quotations, to be sent to the Mayor of Charkow, Russia.

Spain.—December 28th. Tenders are being invited by the municipal authorities of Betanzos, a small seaport town in Galicia, for the concession for the electric lighting of the town during a period of twenty-five years. Tenders to be directed to El Ayuntamiento de Betanzos, Spain.

Windsor.—January 1st, 1896. The Corporation invites proposals for taking over and working its electric lighting orders. All proposals to include the erection and maintenance of a generating station upon a specified site, laying down mains, and necessary equipments, with a constant supply of electricity for lighting purposes in the stated area. Details to be obtained from the Town Clerk, Windsor.

Wallasey.—December 17th. The Wallasey Urban District Council are prepared to receive tenders for fitting up the electric light at Seacombe, Egremont, and New Brighton Ferries. Specification and any further information may be obtained on application at the manager's office, Egremont Ferry, Cheshire, on payment of one guinea, which will be returned on receipt of a *bona fide* tender.

CLOSED.

Bedford.—The Electric Light Committee has accepted the tender of Messrs. Robert Stephenson & Co., Limited, at £467, for the supply of a centrifugal pump and engine, and surface condenser with air pump and engine.

South Western Hospital.—The Metropolitan Asylums Board has accepted the following estimates from the Private Wire and Telephone Installation Company for providing a system of fire alarms and electric bells in connection with the new administrative block:—Fire alarms, £47 3s. 10d.; and electric bells, £24 3s.

Stafford.—The Council has accepted the tender of the Stanton Ironworks Company, Limited, amounting to £65 odd, for the steam main to be laid from the electric light station boiler house to the gasworks boiler house; also that of the Smethwick Boiler Covering Company, amounting to £38, for covering such steam main with non-conducting material. The question of meter rents is under consideration.

NOTES.

New Form of Accumulator.—In the *Chemical News*, recently, Mr. H. N. Warren, research analyst of Liverpool, described a new form of accumulator, which is produced by compressing the spongy lead obtained by the precipitation of lead from a solution of the acetate, and by surrounding this plate with a mixture of metallic lead and litharge in the case of the negatives, and a mixture of specially prepared lead and plumbic peroxide for the positives. In any case these plates are compressed into flat porous pots. Similar arrangements have been tried repeatedly. The introduction of porous pots has always formed a distinct disadvantage by reason of their either disintegrating in the electrolyte or by the action of the cell, or being mechanically destroyed by the expansion of the active material which they were destined to hold. We do not think that any commercial application of this type of accumulator is intended, but even for demonstrations in the laboratory we should think that any of the types in which the plates are not enclosed will be found of greater use, as the behaviour of the plates can of course be more closely observed.

Submarine Boat Pumping.—According to the *Times*, a new submarine boat has been built by M. Goubet, and is shortly to be tried on the Seine. The pumps for admitting water to the reservoir are worked automatically by an electric motor, the motion of which is determined by a manometer, thus enabling the desired depth to be maintained. A like arrangement is employed to secure the longitudinal trim of the boat. The craft is propelled by means of a screw driven by a dynamo.

Northern Society of Electrical Engineers.—On Monday last, Mr. W. P. J. Fawcus was elected president of this Society for the ensuing year, Messrs. S. Z. de Ferranti and C. M. Dorman as vice-presidents, and the following were elected to the Council:—Messrs. Nesbit, John Hesketh, and A. B. Mountain, of Huddersfield. The last three gentlemen will take the seats vacated by Messrs. Blackburn, Corlett and Dorman.

The Cyanide Process.—Those who are interested in the cyanide process should obtain and study a recent paper by E. A. Schneider (*vide Berichte der Deutschen Chemischen Gesellschaft*, 1895, xxviii., pages 1540—1541). It deals with the various methods of detecting small quantities of potassium cyanate in potassium cyanide solutions.

New York Electrical Exports.—The *Western Electrician* says that for the week ended November 8th the exports of electrical material from the port of New York aggregated in value $22,000. The goods were shipped to Belgium, France, Great Britain, Germany, Italy, and to the Central and South American countries.

Lectures and Papers.—Before the Royal Society, yesterday afternoon (December 12th), a paper was read by Prof. J. C. Bose "On the Determination of the Index of Refraction of Sulphur for the Electric Ray."

The following are among the lecture arrangements at the Royal Institution before Easter:—Prof. John Gray McKendrick, six lectures (adapted to a juvenile auditory) on "Sound, Hearing and Speech" (experimentally illustrated); the Right Hon. Lord Rayleigh, six lectures on "Light." The Friday evening meetings will begin on January 17th, when a discourse will be given by the Right. Hon. Lord Rayleigh, on "More about Argon"; succeeding discourses will probably be given by Prof. Burdon Sanderson, Prof. Dewar, and other gentlemen.

Mr. Frederick Walker, C.E., F.S.P.A., read a paper before the Society of Patent Agents at the general meeting of that body on the 11th inst., on "Electrical Nomenclature and the Classification of Electrical Patents." The main object of the paper was to point out the extension of the general terms used in electrical science, and protesting against the classification of the printed specifications at the Patent Office, which are based upon obsolete systems, and render what should be a simple search a formidable and harassing undertaking. Mr. Horn, F.S.P.A., after the discussion, moved "That there should be special divisions of the subject matter indices relating to inventions, and more particularly to electrical inventions similar to what prevails in the United States and Germany." The paper and the resolution together form the subject of a memorial to the Board of Trade.

On Wednesday evening, December 11th, at the Society of Arts, the adjourned discussion on Mr. H. H. Cunynghame's paper on "Locomotive Carriages for Common Roads" was resumed.

Mr. A. H. Seabrook lectured at Yarmouth last week before the St. George's Debating Society on "Electricity."

At Norwich, on 3rd inst., a lecture was delivered by Mr. Arthur Barrett, A.I.E.E., on "Some Modern Applications of Electricity."

On 3rd inst., at the Queen's College, Belfast, Mr. Morton, B.A., delivered a lecture on "Electricity and its Applications."

A lecture was delivered in the Public Hall, Haslingden, on 26th ult., by Mr. F. G. Bailey, M.A., A.M.I.C.E., lecturer on electrotechnics, University College, Liverpool, the subject being "Electricity in Manufacturing Processes."

On 9th inst., Lord Kingsburgh read a paper on "Electricity in the Household," before the Royal Scottish Society of Arts at Edinburgh.

Storage Batteries in Office Buildings.—In a recent article in the New York *Electrical Engineer*, Mr. Charles Blizard, basing his calculations on the annual consumption of an engine under various conditions of load, arrives at the conclusion that in a case where two dynamos, one of 200 ampères, and another of 400 ampères, are used, the net saving per year, if batteries were installed, would amount to about 40 per cent. on the first cost of the plant, apart from the further savings in labour, oil waste, and depreciation of machinery. Another case is mentioned where, prior to the installation of the battery, the dynamo load fluctuated between zero and 150 ampères, while since the installation of the battery the dynamo has been run steadily at 38 ampères, the battery storing energy under light and delivering it under heavy load.

Data for Incandescent Lamps.—Messrs. Slade Templeton & Co. write to us as follows:—"We should be obliged by your correcting a statement of yours under heading 'Data for Incandescent Lamps' in your next issue. You state 'Phæton (German).' This is a mistake; our lamps are made at Niginegen, in Holland, and your statement is likely to injure the sale of them. The Phæton are far superior to those of German manufacture, or they would not have the hold on the market that they undoubtedly possess."

Appointment Vacant.—Mile End Old Town Guardians are open to receive proposals from consulting electrical engineers willing to supervise the proposed electric light undertaking. Further details will be found among our "Official Notices."

New Accumulator Plate.—The *Electrical Engineer*, of New York, recently gave a description of a new accumulator plate, the Rooney "Lamellose," or "twin-pole" plate. The distinctive feature of this plate is that the current passes between the electrodes of opposite polarity on the same support, and obliquely between adjacent plates. Some suitable porous, but non-conducting, substance is provided with perforations, and used as grid or support for the active material. Alternate vertical rows are of the same polarity, adjacent rows of opposite polarity, and the compound plates are so arranged in the cell that the rows facing each other are of the same polarity. Perforated lead strips in contact with all the pellets in one row serve as conductors for the current. It is claimed for this construction that it obviates the danger of short-circuiting. There seem to be, however, serious shortcomings in the cell as described. The support being made of paper board, there is a risk of the layer between adjacent strips of opposing polarity becoming destroyed, which would result in short-circuiting, and the mode of conveying the current by means of lead strips pressing against the pellets is certainly not so satisfactory as a solid lug forming part of the grid or support. The current passing obliquely, the action at different parts of the strip would not be uniform, and this seems to us to form one of the most serious drawbacks to such construction. Similar arrangements with oblique plates have been tried with ordinary types of plates, and have been discarded for the above reason. It would be interesting to learn the results obtained with a battery of these cells, either for stationary work or on a tramcar.

The Institution of Junior Engineers.—At last Friday's meeting of this Institution, the paper read was on "Urban Roads and Footways, with Notes on Gas, Water, and Electric Mains, &c., in Connection Therewith," by Mr. J. Julian, of the Borough Engineer's Office, Cambridge. After preliminary remarks, the author proceeded to consider the laying of tramways. It was shown how great was the proportion which the roadwork bore to the other expenses of tramway track construction. A brief description followed of the overhead and conduit, electric, and the mechanical cable systems; and the underground works of a road were then reviewed. Various modes of laying electric mains were described, and particulars were given as to cost, and of methods for determining the size of conductor, and other data.

The Hatch Storage Battery.—The Hatch Storage Battery, as described in the *Electrical Engineer*, New York, November 6th, 1895, will, we think, not find many admirers in Europe. The use of porous earthenware on which to place the active material and the binding of the plates with wooden boards and rubber bands, the liability of the material flaking off the support, the tendency to sulphate, the introduction of foreign material, and the increase of resistance, will be considered by European electrical engineers a distinctly retrograde step.

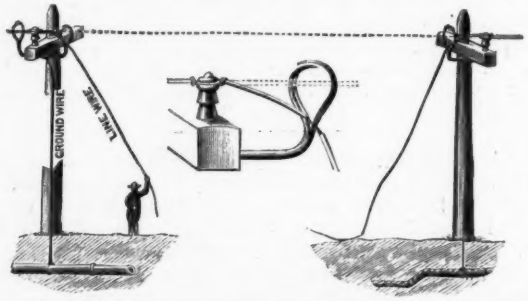
House Wiring in Germany.—The following is a copy of a telegram shown to us by Mr. Fred Bathurst, which has been sent to him by Mr. Seubel, of Messrs. Bergmann & Co., of Berlin, who are introducing the interior conduit wiring system into Germany:—

> Association of German Electrical Engineers, through their committee on installation rules, in session at Eisenach, November 23rd, prohibited unanimously the use of wooden casings. The expert of German fire insurance companies present was foremost advocating exclusion of wooden casings.

Personal.—We learn that Mr. H. Lavington Fletcher, A.M.I.C.E, who was the resident engineer on the Coventry Electric Tramways contract for the General Traction Company, Limited, has now proceeded to Douglas to superintend the laying and equipment of the Douglas Southern Tramways, on the Douglas Head marine drive, which is being carried out by the General Traction Company.

Sanitation at Southport.—The Town Council is obtaining a report on the practicability of applying the Hermite process to the sewage system.

Safety Appliance for Live Wires.—Mr. A. E. Hutchins, of Detroit, has devised a simple apparatus, as shown in the illustration, for diverting any dangerous current in the case of the breaking of a street circuit. According to an American contemporary, he puts a small wire on a pole similar in purpose to a lightning rod for a house; the top of this wire is split into a fork or fastened to a specially made insulated metallic bracket; the bottom of the wire is run into the ground, where it may be connected to a special ground wire or a water or gas pipe. This bracket or crotch only touches a bare spot on the suspended dangerous wire when it falls; then it operates to carry the deadly current down the pole wire to the ground. Electrically speaking, it provides for the electric current a low resistance shunt, and places the fallen wire at earth potential, similar to the ground current of an electric railroad. The inventor also claims that his device protects from any additional grounded dangerous wires at other points on the line. Mr. Hutchins made not long since a test at the station of the Peninsula Electric Light Company, in Detroit. In this test, he says, he complied with the requirements of protection to life from a broken section of line wire, and also from a super-imposed wire grounded in moist earth 250 feet distant from operating grounds. This line



carried a 3,000-volt arc light circuit from a 75-light Brush machine, one span (on one leg or polarity) of which was guarded at each pole by Hutchins's bracket or receiver, and when this span of wire was severed he picked up either end of the fallen wire engaging the naked wire, there being at the time a 3,000-volt potential ground (from the opposite polarity of the machine) playing through the ground from moist earth ground 250 feet away. The protecting brackets were grounded each to a water pipe. In this test Mr. Hutchins says he could not perceive the least current passing through himself, even when he approached to within 100 feet of the point where the special wire was grounded in moist earth. It is claimed that though no new principles of electrical science are involved, this is a new application in taking advantage of conditions afforded by the earth as a low resistance conductor operating to afford protection, or relieve a conductor of higher resistance, such as the body of a man.

Electrical Engineering in Norway.—We learn from Christiania that a committee has been appointed to secure the establishment of a large electro-technical laboratory in that city.

Technical Education.—A class has been opened in the Belfast Technical Schools for teaching electric lighting and power transmission.

NEW COMPANY REGISTERED.

Woking Electric Supply Company, Limited (46,175).—This company was registered on December 5th with a capital of £20,000 in £1 shares, to enter into an agreement with A. New and A. J. Mayne, and to carry on at Woking and the neighbouring parishes the business of an electric light company in all its branches. The subscribers (with one share each) are:—E. Mann, 23, Gordon Place, Kensington, electrical engineer; C. E. Masterman, Northwood, Middlesex, civil engineer; W. J. Rundle, 219, Earlsfield Road, S.W., electrical engineer; C. G. Bromfield, Cottage, Woking, electrical engineer; F. Wright, 31, Pretoria Avenue, Walthamstow, clerk; W. Whorman, Penrhyn Road, Kingston, S.W., secretary; A. Branch, 3, Avenue Street, Chadwell Heath, electrical engineer; A. A. E. Rundle, 5, Mantua Street, Battersea, joiner. Registered without articles of association by W. Haigh, 10, Coleman Street, E.C.

CITY NOTES.

Guildford Electricity Supply Company, Limited.

THE fourth annual general meeting of this company was held at the County and Borough Halls, Guildford, on Wednesday last week.

Mr. A. F. ASHER presided, and in presenting the annual report and balance-sheet on behalf of the directors, congratulated the company on having been successfully floated within the past two months. It was explained, for the benefit of those shareholders who had only recently taken an interest in the company, that the company was formed under the name of the Holloway Electricity Supply Company, Limited, in 1892, and that under that name it first applied for a provisional order of the Board of Trade for powers to supply electricity for lighting purposes at Guildford. The name of the company was in 1894 changed to its present form. The chairman, in mentioning these facts, referred to the way in which the company had, in its earlier stages, been opposed by the municipal authorities of Guildford, the result of such opposition being that the company obtained a concession for 35 years under the Electric Lighting Acts, which is probably one of the longest terms ever granted to a company of this kind, and much longer than the company could have hoped to get if its scheme had been unopposed by the Town Council. The authorised capital of the company is £20,000, in 3,900 ordinary shares of £5 each, and 500 founders' shares of £1 each. Sufficient capital has already been subscribed to go to allotment, a contract for the works, mains, machinery, &c., has been signed, and an excellent site for the works obtained; also that there is every probability of the current being supplied for lighting and other purposes during the next few weeks.

Messrs. Asher and Colebrook, the directors retiring by rotation, were re-elected.

Cassel Gold Extracting Company, Limited.

AT the annual meeting held on Wednesday in Glasgow, Mr. D. S. CARSON, the chairman, said, with reference to their patent rights, the MacArthur-Forrest patents now stood at £13,958. The profit for the year, after deducting all the working expenses, &c., was £33,146, from which amount they had written off £14,550 for depreciation of the MacArthur-Forrest patents, and £1,320 for depreciation of buildings, machinery and plant, leaving a net credit balance of £17,276. Out of this sum the directors proposed to pay a dividend of 5 per cent. on the paid-up capital, which would absorb about £11,375, and they recommended that £5,000 be added to the suspense share account, and the balance of £901 be carried forward. Taking a general view of the whole of their business, he thought they were justified in saying that the outlook was very encouraging, and that the prospects of business for the current year were distinctly good.

The Electric and General Investment Company, Limited.—The directors have declared an interim dividend on the capital paid up on the ordinary shares of the company at the rate of 10 per cent. per annum, for the six months ending November 30th, 1895, the dividend to be payable on and after the 23rd inst.

The transfer books and register of members will be closed from Monday to December 23rd inclusive, for the purpose of preparing the warrants for the interim dividend on the ordinary shares.

Brazilian Submarine Telegraph Company, Limited. A dividend of 3s. per share, payable on the 20th inst., was declared at a board meeting held on November 27th last.

Stock Exchange Announcements.—The Stock Exchange Committee has ordered the undermentioned securities to be quoted in the Official List:—Amazon Telegraph Company, Limited—25,000 shares, Nos. 1 to 25,000. Chelsea Electricity Supply Company, Limited—Further issue of 3,723 ordinary shares, Nos. 10,278 to 14,000.

Eastern Extension, Australasia, and China Telegraph Company, Limited.—The share register will be closed from 7th to 14th prox., both days inclusive. The coupon of the 5 per cent. Australian Government subsidy debentures, due January 1st, will be paid on and after that date at Messrs. Barclay, Bevan & Co.'s Bank, 54, Lombard Street, E.C. The directors have declared an interim dividend for the quarter ending September 30th of 2s. 6d. per share, free of income-tax.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending December 8th, 1895, amounted to £977; week ending December 9th, 1894, £941; increase, £36; total receipts for half-year, 1895, £20,527; corresponding period, 1894, £20,518; increase, £9.

The Great Northern Telegraph Company. The traffic receipts in November, 1895, were £24,800; January 1st to November 30th, 1895, £286,400; corresponding months, 1894, £261,000; corresponding months, 1893, £248,400.

The Liverpool Overhead Railway Company. The receipts of this railway for the week ending December 8th, 1895, amounted to £1,042; corresponding week last year, £855; increase, £187.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 6th, 1895, after deducting 17 per cent. of the gross receipts payable to London Platino-Brazilian Telegraph Company, Limited, were £2,978

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation Dec. 4th.	Closing Quotation, Dec. 11th.	Business done during week ended Dec. 11th, 1895. Highest.	Lowest
173,400£	African Direct Teleg., Ltd., 4 % Del	100	...	4 %	4 %	101 —105	101 —105	...	...
1,912,880£	Anglo-American Teleg., Ltd.	Stock	£2 15s.	£2 11s.	£2 2s.	44 — 46	44 — 46	...	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 10s.	£5 2s.	£4 4s.	84 — 85	84 — 85	85	84
2,993,560£	Do. do. Defd.	Stock	...	...	...	6¼— 6⅝	6¼— 6⅝	6¼	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6¼% §	6¼% §	...	13 — 13½	13 — 13½	13½	13⅛
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	111 —115	111 —115	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	10% §	... §	2½%	3¼— 3⅜	3¼ — 3⅜	3	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	164 —168	164 —168	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	2 % §	1½%	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	13 — 14	13 — 14	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20½— 21½	20½— 21½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½— 4½	3½ — 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	...	4½%	104 —107%	104 —107 %	...	...
60,710	Direct United States Cable, Ltd.	20	3½% §	2⅝% §	2 %	8¼— 8⅜	8¼— 8⅜	8⅜	8⅛
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6¼% §	6¼% §	6¼%	16 — 16½	16 — 16½	16⅜	16⅛
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 % §	6 %	17½ — 18	17½ — 18	17⅝	17½
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5 %	107 —110	107 —110	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	125 —128	125 —128	127½	126½
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17 — 17½	17 — 17½	17 7/16	17 7/16
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	102 —106	102 —106	104½	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	103 —106	103 —106	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	126 —129	126 —129	...	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	102 —106	102 —106	...	..
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	103 —106	103 —106	104½	.
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	108 —111	108 —111	110	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	112 —115%	112 —115 %	..	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅞% §	4⅝% §	4⅛%	9½ — 10	9½ — 10	9⅞	9⅝
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 %	16½ — 17	16½ — 17	16 13/16	16⅝
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝% §	8⅝% §	8⅝%	21½ — 22	21½ — 22	...	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	46 — 49	46 — 49	48	47
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	106 —110	106 —110	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	...	...	...	2 — 2½	2 — 2½	...	...
484,557	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 % §	5 %	6 — 6¼	6⅛ — 6⅜	6 7/16	6 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 18	16 — 18	17 7/16	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15½— 16½	15½— 16½	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6¼— 6⅜	6⅛ — 6⅜	6 5/16	6⅛
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 —107	106 —108	107	106½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	4¼%	1/16— 1/8	1/16— 1/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	109 —112	109 —112	...	...
11,839	Reuter's Ltd.	8	5 %	0 %	*nil*	5 — 6	4 — 5	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	127 —132	127 —132	...	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	2½— 3	2½— 3	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	92 — 97	92 — 97	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	..	...	*nil*	5½— 6½	5½— 6½	...	...
238,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	102 —105	102 —105	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1 — 2	1 — 2	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	98 —103	98—103	...	...
54,248	Western and Brazilian Teleg., Ltd.	15	2½%	2½%	3 %	9½— 10 xd	9½— 10	..	...
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½— 6⅝xd	6½— 6⅝	6½	...
33,129	Do. do. do. Def. Ord.	7½	...	...	1 %	3½— 3⅝	3 — 3½	...	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
88,321	West India and Panama Teleg., Ltd.	10	½%	½%	½%	7/8— 1⅛	7/8— 1⅛	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10 — 10½	10 — 10½	10⅜	10 3/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	8½— 9½	8½— 9½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	111 —114	111 —114	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	110 —115	113 —118	115½	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	100 —103	100 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	4½%	4½%	5½— 5⅝	5½— 5⅝	...	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	2½%	5 %	5 %	6¾— 7¼	6¾— 7¼	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	...	115—118	116 — 119	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	5 %	13 — 13½	12⅝— 13¼	13 3/16	12⅝
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15⅝— 16¼	15⅝— 16¼	16⅛	15⅝
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	132 —136	132 —136	135½	133¾
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	...	8¼— 9¼	8¼— 9¼	8½	..
10,000	Do. do. do. 6% Pref., £6 pd., 40,001—50,000	10	...	...	...	8½— 9	8½— 9	...	...
50,000	†Liverpool Electric Supply, all paid	5	5 %	5 %	5¼%	7⅞— 8⅛	7⅞— 8⅛	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2 %	2¾%	3 %	10½ — 11½	10½— 11½	10⅞	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	117 —120	117 —120	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	1 %	8½— 9	8½— 9	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	7½%	4½%	6¾%	8 — 8½	8 — 8½	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	3½%	4 %	5 %	8 — 8½	8 — 8½	8⅜	8 3/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, Dec. 4th.	Closing Quotation, Dec. 11th.	Business done during week ended Dec. 11th, 1895. Highest.	Lowest
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	3	6 % §	6 % §	...	1½ — 1⅝	1½ — 1⅝	1⅝	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	6 % §	...	1⅝ — 2⅛	1⅝ — 2⅛	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	112 —115	112 —115	114½	112½
630,000*l*	City and South London Railway	Stock	8%	8%	1½%	40 — 42	40 — 42	...	...
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 % §	7 % §	...	2 — 2½	2 — 2½	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	...	...	5 %	1⅞ — 2¼	1⅞ — 2¼	...	...
17,139	Do. do. do. "A" Shares 01—017,139	5	...	...	...	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	...	4½%	104 —107	104 —107	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	*nil*	⅝ — ¾	⅝ — ¾	⅝	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	— 2½	2 — 2¼xd	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	2¼ — ⅓	⅜ — ⅝	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅜ — ⅝	½ — ¾	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	...	¼ — ½	¼ — ½	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	*nil*	...	7 — 8	8 — 9	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	6 %	13½ — 14½	13½ — 14½	14½	...
3,000	Do. do. do. 7% Pref.	10	...	...	...	15½ — 16½	15½ — 16½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	..	...	...	108 —111	108 —111	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	10 %	18 — 19	18 — 19	18⅜	17¾
200,000*l*	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	101 —103	101 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	1 %	1½%	11⅜ — 11⅝	11⅝ — 11⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	...	5 %	5 %	15½ — 15⅝	15½ — 15⅝	..	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	20 %	20 %	39 — 41	39 — 41	40½	39½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
54,000*l*	Waterloo and City Railway, Nos. 1 to 54,000, £4 paid ...	10	...	...	...	4⅜ — 5	4⅜ — 5	4⅝	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50°/ for 189

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0°/₀; 1891—7°/₀; 1890—8°/

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅞—6¼.

Electric Construction Corporation, 6 % Debentures, 98—102.

House-to-House Company (£5 paid), 4—4½.

Do. do. 7 % Preference, of £5, 7⅞—8¼.

Do. do. 4½% Debentures of £100, 110—112.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 7½—8; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.

Liverpool Electric Supply, £5 (fully paid), 7½—8.

London Electric Supply Corporation, £5 Ordinary, ⅜—½.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7—7½.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

Concentric Wiring. By Sam. Mavor, member. (Paper read November 28th, 1895.)

(*Concluded from page* 715.)

Switches have been greatly improved during the last few years, both in mechanical design and in external form. The clumsy switches, with the ugliness of their porcelain covers embellished by gilt lines or floral decorations, have now nearly disappeared. They are superseded by switches of neat appearance, with suitable metal covers. The working parts of the switches are of a much more mechanical type than formerly, but there still remains ample room for improvement. There are far too many parts, too many screws, and too many contacts. The practice of dispensing with binding screws, and soldering the wires directly to the contact plates should be highly commended. How often one sees the attempt made to secure the ends of conductors—frequently of considerable size—under paltry little cheese or round headed screws, and washers absurdly too light and inadequate to the purpose!

The ceiling rose is also a weak spot in double wiring. There are far too many contacts in it. To begin with, there is the usual crockery base, and upon this base are three little brass plates, with twice that number of brass screws. Each of these six little screws binds to a contact the end of a conductor or fuse, and every screw of them is liable to become loose, and every contact to become oxidised. Where vibration or moisture are present, the development of trouble is only a question of time. Do those who so freely erect these little collection of screws and contacts ever consider the harvest of petty troubles and annoyance which will be reaped by-and-by?

We must now pursue our painful path of adverse criticism to the lamp-holder. The double contact lamp-holder, especially when attached to flexible pendants, is the frequent seat of short-circuit and minor troubles. In this little piece of apparatus there are two contact plates, carrying the buffer springs and the inevitable binding screws. Each of these contact plates must be insulated from the other, and both from the surrounding metal tube. When this is done, small space remains for further intrusion. But the flexible conductors are still to be brought in and pinched under the binding screws. Stray strands from these flexibles, where they are not most carefully soldered, are frequently responsible for short circuits and the melting of many fuses. The risk would be reduced if here also binding screws were dispensed with, and the wires brought straight through the insulating disc into holes in the plates, and soldered therein.

It is with a sense of relief that one turns from double wiring and all its attendant ills to the simple mechanical and straightforward methods of concentric wiring with an uninsulated outer conductor. So far as the writer is aware, no system of concentric wiring, in which both the inner and outer conductors are insulated, has ever been used for indoor work. It appears probable that the difficulties in the way of designing junctions, switches, and other accessories which shall meet the electrical and mechanical requirements within moderate dimensions and at reasonable cost, will prevent the introduction of such a system. Two and three-wire concentric cables, with each conductor insulated, are largely used in mains in connection with two and three-wire systems, but in such cases there is no difficulty in providing junction boxes of adequate size. The only system of concentric wiring which has been adopted for internal use has an uninsulated outer conductor, and it is this system that is known as "concentric wiring." It is important that it be clearly understood that concentric wiring is not "single wiring," but is something essentially different. This distinction between concentric wiring and single wiring is necessary, because the two have been frequently confused. No method of wiring merits the title "concentric" which is not consistently concentric throughout. In a concentric system, the central conductor must be everywhere surrounded over its insulation by a metallic sheathing of conductivity equal to, or greater than, the core. The switches and fuses should be in the central wire, and enclosed in metal cases. These cases or boxes should be electrically and mechanically jointed to the outer conductor, and so form part of the continuous metallic envelope in which the central conductor is enclosed.

It must be pointed out here that, under the existing Board of Trade regulations referring to the insulation of electric light supply mains, concentric wiring is not admissible where connection has to be made to a source of public supply in this country. This is a matter to which we shall recur, and shall meanwhile consider the question of concentric wiring with regard to installations supplied with current from independent plants. The adoption of concentric wiring is the royal road out of the difficulties and dangers which beset double wiring. It seems to be difficult for those who have been accustomed to devote so much pains to attain good insulation of both conductors to realise that there is no necessity for doing so. The adoption of concentric wiring dispenses with this necessity, and abolishes risks which make a high standard of insulation of both conductors in a two-wire system so desirable. Much misunderstanding

and prejudice, due to lack of information, exist with regard to concentric wiring; but there is complete absence of valid objections to its use, and prejudice against it is soon dissolved by an acquaintance with the system.

Some of the fire insurance companies were at one time rather suspicious of concentric wiring, probably because they feared its adoption would lead to the abolishing of their cherished rules regarding the width of fillets in wood casing, &c. The insurance companies are, however, now unanimous in their favourable verdict on the subject, and have recognised the advantages of concentric wiring from their point of view. More extended experience and appreciation of its fireproof qualities must confirm the preference many of them now have for concentric wiring.

It has been stated that, owing to one conductor being already earthed, the liability to complete breakdown of the insulation is doubled. This might be true of double wiring, but is certainly not true of concentric. The outer conductor being already at earth potential, there cannot be any risk whatever of shock or spark being experienced from it. There is thus only one vulnerable conductor, and this, with its insulation being encased throughout its entire length in the metallic sheathing formed by the outer conductor, is well protected against injury. The consequences of injury to concentric and to double wiring are essentially different. In the case of the concentric conductor, if it should be crushed or a nail be driven into it, the instantaneous result is a dead short-circuit and the melting of the fuse. If the insulation should be punctured and moisture gain access, the distance across the insulation between the conductors is so small that the fault immediately develops into a short-circuit and the spark passes from the centre conductor to the inner surface of the metallic sheathing; and, being entirely within the sheathing, it cannot communicate fire to its surroundings. Concentric conductors are thus self-testing. Faults cannot endure. They cut themselves out automatically. Or, rather, this is what they would do if faults were experienced, but we never have faults in lead-covered concentric conductors. How different is the case of ordinary double-wire conductors laid in the separate grooves of a wood casing! The casing which is provided for mechanical protection may become a positive source of danger, and may be ignited by leakage across the fillet—a danger which the fuse is powerless to prevent. In concentric wiring there is only one cable to handle instead of two, and, this carrying its own protection, the necessity for wood casing is abolished.

Perhaps the most conspicuous advantage of concentric wiring is that it may be so easily and so effectually made waterproof. The cables may be enclosed in lead sheathing laid under or over the outer conductor, and hermetically sealed to the various apparatus into which the cables are led. This must appeal to all those who have had a varied experience of wiring. If moisture—the arch enemy of good insulation—can be permanently excluded, it means the permanent maintenance of a high standard of insulation, and consequent freedom from trouble.

The next important advantage to be claimed is the large reduction in the number of fuses. The drastic method of abolishing fuses is to maintain the section of the conductors. This can readily be done in concentric wiring to an extent impracticable in double wiring. Conductors of much larger section may be conveniently and safely led into C.C. lamp-holders, ceiling roses, and wall sockets than is possible in double wiring. And thus, by maintaining the section of conductors right into the lamp-holders, many of the objectionable fuses are abolished. The fuses when reduced in number are more easily centralised and arranged in groups of standard size. It may be objected that if the number of fuses is diminished a larger number of lamps are affected in the event of a fuse being melted by a short-circuit. This is a very natural objection for one experienced in double wiring to offer. But it has no application to concentric wiring. We never have short circuits. It is in double-contact lamp-holders and double-wire flexibles, ceiling roses, and the like, that short circuits occur. Compare a central contact and a double contact lamp-holder. A 7/16 concentric cable may be led into the former more easily, and with greater safety, than two single No. 16 L.S.G. wires or their equivalent can be led into the latter. It is not necessary to lead 7/16 cables into concentric lamp-holders, but the possibility suggests the large margin of safety in favour of the C.C. holders. The difficulty of avoiding mishaps in double-wire lamp-holders will be emphasised by the introduction of 200-volt lamps. While on the subject of lamp-holders, it may be noted that, there being only one buffer spring in the C.C. lamp-holder, and that exactly in the centre, there is less risk of twisting lamps out of their collars while inserting or removing them. Concentric lamp-holders, ceiling roses, and such fittings, have only one—and that a central—contact to be insulated, may be made of better mechanical design than where within the same space two contacts have to be insulated, each from the other, and both from the containing case. The benefit of the great reduction in the number of parts can hardly be exaggerated, the liability to derangement is so very greatly reduced.

In regard to fittings, the comparison is again in favour of concentric wiring. The flexible conductors of which the pendants are made are of such large section that they are mechanically strong. The pendant terminates at either end in a screwed brass nipple with insulating plug and central contact—an arrangement which is substantial without being clumsy. No loose strands are possible. The top nipple of the pendant is screwed into the junction or fitting base, and the nipple at the lower end is screwed into the lamp-holder. The brackets are similarly wired to screwed nipples with central contacts. The erection of fittings is therefore an extremely simple operation, and the labour so employed is reduced to a minimum.

The method of concentric wiring illustrated by the patterns before you is based upon a full recognition of the fact that electric light wiring, in order to be permanently durable and reliable, must be impervious to moisture. So far as the writer is aware, this is the only method of wiring which provides a continuously waterproof metallic sheathing over the insulation from the main switchboard to the lamp-holders. The main switchboard has the usual single-pole switch and fuse arrangement, and the board is surrounded by the negative omnibus bar, which receives in sockets attached to it the outer conductors and sheathings of the concentric cables. The main cables—which are lead sheathed throughout, and are generally armoured with galvanised iron wires laid over the lead on a cushion of jute—are carried without break or joint direct to their respective distributing boxes, where the central conductors are soldered to the omnibus bars and the outer conductors terminate in gun-metal sockets secured to the boxes. The distributing boxes are of cast iron or cast brass, enamelled white inside, and fitted with fuses, or switches and fuses, as required. These boxes have close backs and hinged fronts closing upon an india-rubber ring, thus rendering them proof against dust or moisture. The concentric branch cables which radiate from these boxes are under all ordinary circumstances of uniform section namely, 7/21½—equal in area to 0·005 square inch. The outer conductor of the cable has the same section of copper as the core, and the whole is enclosed in a solid drawn tube of lead. Wherever a joint is to be made or the cable led into a switch or fitting base the centre wire is soldered to its contacts, and the outer conductor and its lead sheathing are received and terminate in a jointing pocket cast upon the switch-box or junction. The central wire and its insulation are thus enclosed throughout their length in a hermetically sealed metallic sheathing. The section of the branch conductor 0·005 square inch is carried into every switch and into every lamp-holder, no reduction being made. There is no necessity for any fuses other than those in the cast-iron fuse-boxes, and these are all uniform and interchangeable. It is very rarely that occasion requires any departure from this plan. Many large installations have been carried out on the lines indicated, some of these amounting to several thousands of lamps, where only two sizes of fuses—main and branch, respectively uniform and interchangeable—have been used. The simplicity and reliability of such a system must be too obvious for emphasis.

The branch cables are led through buildings like flexible gas pipes, but they are not liable to damage as composition gas pipes are. The conductors and the insulation within the lead sheathing serve as a backing for the lead, so that it is not at all easily damaged. It has been the custom of the writer's firm for years to have their concentric conductors and joints embedded in the plaster of new buildings, and they have never known a single instance of a fault developing in conductors so treated. It is sometimes objected that where the conductors are so buried they are not accessible. They certainly are not. Why should they be? It is essential that wood casings carrying ordinary double wiring should be accessible; further, it is desirable that they should be visible wherever possible. But the conditions with regard to lead-covered concentric conductors are entirely different. Given a conductor and joint of imperishable materials, and impervious to moisture, and the acids found in plaster and cement, and no reason remains for laying conductors on the surface, or of providing access to them where enclosed in plaster. This demand for accessibility, and the objection to cover conductors with plaster, is a relic of the times when India-rubber covered conductors laid in wood casing were embedded in walls. The bitter experience which rapidly follows this practice results in the prejudice against covering any conductors with plaster. If anyone wishes to have his conductors laid on the surface of plastered walls, by all means let him do so, but there is no necessity either to lay them on the surface, or to provide access to them where lead-covered concentric conductors are used. Access to the distributing boxes only is necessary.

Another bogey is the chance nail driven into the plaster. Consider how largely the practice of embedding composition gas pipes in plaster is in vogue, and how immeasurably greater is the danger resulting from the piercing of such a pipe than from piercing the insulation of a conductor. Yet how seldom one hears any objection to the practice! If a nail is driven into a concentric conductor, the immediate result is an emphatic short circuit, and the fuse melts; there is not the slightest danger. Two cases only of nails piercing embedded conductors have come under the writer's notice. Both of these were in the same building, a block wired for about 500 lights, where all the conductors were embedded in plaster. The faults—one behind a picture moulding, and the other behind a dado—were readily localised, and repaired before the work was completed.

The insulation resistance of the wiring in a new building is not a matter which causes any anxiety. The lead sheathings and brass junctions and switch-boxes make one independent in this regard. In occupied buildings the lead-covered branch conductors may be led about under floors and behind plaster and linings with the greatest freedom and complete immunity from danger. The amount of lifting of flooring and disturbance to woodwork and plaster is only a fraction of that required for the carrying out of wood-cased double wiring.

The junctions employed, specimens of which are upon the table, may be manipulated by any intelligent man who can use a soldering bolt. No careful lapping of insulating material around the joint is required. The insulation is air space, and there is none better. The branch conductors being of uniform size—so are the junctions—and men soon become expert in jointing. The operation is so very simple and easily performed, that it may safely be done by unskilled labour. This feature specially adapts the system for export. As an illustration, it may be stated that a squad of Hindoos, chiefly tinsmiths, under the guidance of one European, carried out in the most satisfactory style the wiring for 3,000 lamps in 10 weeks.

In mills or factories floored with wood the conductors are cleated to the woodwork with brass cleats; and where iron beams and concrete floors are met, the conductors, with junctions (tapped to receive the pendants) attached at the proper intervals, are secured by brass or copper cleats to stranded steel suspending wires strained between eye-bolts attached to the walls. The laborious plugging of the con-

crete ceilings, with the resulting dust and disturbance to the work of the factory and expense to the wiring contractor, is entirely abolished. In single-storey weaving sheds, iron works, or other buildings with iron roofs divided into bays, the same method of suspending the conductors between the beams or tie-rods is adopted.

In support of the claim that this method of wiring is reliably waterproof, the case of Messrs. Nobel's Explosives Company's West Quarter Factory may be cited. The buildings to be lighted are isolated and scattered over a large area, in order to reduce the risk and minimise the effect of explosions. The regulations issued by the Home Office regarding electric lighting were so very stringent, that it was impracticable to comply with them except by the use of concentric wiring. With concentric wiring everything was made easy. Its waterproof and fireproof properties overcame all the difficulties. Every joint, and every yard of the conductors, is outside and exposed to the weather, cleated, for most part, to the gangways. The switches, of cast brass, and distributing boxes, of cast iron, are also all outside, protected only by water sheds. The work of wiring was completed more than three years ago, and, notwithstanding three years' exposure to the elements in this climate, the insulation resistance is as high as ever. Monthly tests of the insulation are required by the Home Office, and on the 10th of last month the insulation resistance was two and a half times higher than the most stringent of the fire office rules require for *indoor* wiring. In the nitrating department of the same factory, which is a quarter of a mile distant from the other installation, the insulation is equally satisfactory, although the wiring is subjected to the profuse fumes of nitric acid. It is noteworthy that the insulation of the wiring at both these places is not India-rubber, but is fibrous. The exclusion of moistnre is therefore solely due to the lead sheathing and waterproof nature of the joints.

The more difficult the wiring of a building appears to be, the more favourable is the comparison to concentric wiring. The iron roofs, concrete floors, moisture, and other ills that vex the spirit of the double wirer, have no terrors for his concentric friend. For wiring in any situation, from collieries to boudoirs, where difficulties or erection have to be faced, or in situations where the conductors, &c., after erection must endure excessive heat or cold, moisture, acid vapour, or inflammable dust, concentric wiring meets the case. Conviction of its immense superiority is immediately impressed by inspection of buildings so wired. The thing requires to be seen to be appreciated. Concentric wiring has this further advantage—that a very simple and easily followed set of rules can be framed, which are applicable to wiring, to be carried out under widely differing conditions.

Contractors who are unacquainted with concentric wiring are often ready, when they know it is in competition with their double-wire tenders, to pour into the ears of their prospective client a dismal tale of the woes which would follow the adoption of any system which would not embrace their precious wood casing and crockery ware.

If those contractors were informed on the subject, they would learn how great is their error. Take a contractor who has had experience of concentric wiring into any building whatever, and he will show how to make a better, more mechanical, reliable, and durable job, and generally at less cost, than is possible with double wiring.

Those who have used only double wiring, and know no other, are reluctant, and with reason, to depart from practice in which their patterns are systematised and standardised, and in which their staff are trained. But when the change proposed is all in the direction of simplicity and reduction of labour the chief objections to its adoption are removed.

That fires or minor troubles are not more frequent in badly-wired buildings is a fine testimonial to the safety of electric light wiring, but is no excuse for the continuance of slipshod work or adherence to existing methods where improvements are possible.

For mining work concentric wiring is specially adapted. The mechanical nature of the fittings and the ease with which they and the conductors may be made waterproof are important features. A concentric cable for mining purposes is more safe than two separate cables. A fall of material from the roof may rupture one of two conductors, and, if current is passing, the inevitable result is a spark at the point of parting. In fiery mines this might have serious consequences. With a concentric conductor, however, the fall would crush the outer conductor in upon the core, and so cause a dead short-circuit and melt the fuse before the cable parted. The spark would thus take place at the fuse at the pit bank. In the only case of such accident within the writer's experience the fuse did promptly melt. Several devices have been proposed for the purpose of preventing a spark at the point of rupture of cables used in pit work. There is room for doubt as to the likelihood of these devices performing their functions in case of need. There can be no question that the concentric cable is much more simple, and it is probably more reliable than any of them. Further, none of these arrangements afford to the miner the immunity from personal danger from shock which the concentric cable does. An E.M.F. of 500 volts is frequently used for such work, and it is usually considered that such a pressure, although sufficient to give a disagreeable shock, is not dangerous to life. That this feeling of security is not well founded is unfortunately proved by recent fatal accidents. For power transmission in mines an ideally safe system is furnished by concentric cables with earthed sheathing, and switches, fuses, and other appliances enclosed in cast-iron cases, also earthed, and, if need be, enclosed-type motors with their casings earthed.

With regard to the wiring of ships, it is well known that an essential condition of durable wiring is that it shall be waterproof throughout. The British Admiralty for years tried all that the best materials of the usual double wiring sort and most careful workmanship could do to secure the desired result. But the incessantly recurring faults and derangements drove them six years ago to abandon wood casing and the ordinary rubber insulated conductors, and no longer to attempt the impossible. At the time indicated they discarded wood casing and adopted in lead sheathing of the conductors the most effectual means of rendering them permanently waterproof.. It was not, however, till four years later that they fully faced the question of making the wiring systematically waterproof throughout. Cast-brass distributing fuse boxes, and cast-brass switch-boxes, all of waterproof patterns, were then adopted, and means taken to make watertight joints between these boxes and the lead conductors. The present patterns of distributing boxes, &c., although they serve their purpose, are still capable of improvement, and their awkward styles admirably illustrate the difficulty of designing waterproof fittings for use in a double-wire system, where the two sides of the circuit must be insulated from each other, and both from metal of the containing boxes.

The Admiralty still adhere to double wiring, owing to fancied danger of compass disturbance from concentric wiring. In the early days of electric lighting, some of Her Majesty's ships were single wired, and had dynamos of unsuitable types injudiciously placed. The results were compass disturbance. (The risk of compass disturbance, even from single wiring, are as nothing when compared with those which may arise from the dynamos.) The navigating officers naturally became alarmed, and the alarm has not yet subsided. That well-arranged concentric wiring has no effect whatever upon the compasses of a ship has been proved by the most careful tests. The waterproof qualities of concentric wiring, and the safety from fire which it ensures, particularly adapt it for use on board ship.

The history of the development of electric light wiring in our Navy is highly interesting and instructive. The conditions to be endured by wiring on board ship are admittedly severe; but it is under these circumstances that the inherent defects in a system will be most rapidly disclosed. We may profit by the experience of the Admiralty, and accept their progress as an index to the direction in which wiring practice on shore should be improved. The same defects which led to the abandonment of double wiring in wood casing in the Navy exist in this system when applied to land work. The conditions on shore are less trying, and severe treatment less frequent, but the same inherent defects are there, and only await opportunity to develop.

And now with regard to possible electrolysis, due to difference of potential along the outer conductor. In isolated installations, where the distances are short the question of electrolysis may be dismissed as having no bearing. In cases where the distances are considerable the risk of electrolysis may be entirely avoided by adopting very simple precautions. The first of these—suggested to the writer by Mr. T. B. Murray—is to so proportion the conductivities of the inner and outer conductors that the fall in volts shall be nearly all in the inner conductor, the copper saved from the inner conductor being added to the outer in order to reduce to a minimum the difference of potential between its ends. Another method adopted by the writer is to provide between the outer conductor and its lead sheathing a very light insulation, and to earth the outer conductor only at the distant end. The layer of braiding laid for manufacturing reasons over the strands of the outer conductor before it is passed through the lead press is sufficient for the purpose, as the maximum difference of potential between the outer conductor and the lead is only a few volts.

The risk of electrolysis is greatly over-estimated. The prejudice against earthing the return conductor is largely due to the results of the early American practice of using an earth return for street railway circuits, instead of providing an adequate return conductor. The consequence of this habit was serious damage by electrolysis to gas and water mains. But what were the conditions? In many cases the current was put to earth at the distant points at 50 volts to 100 volts above the E.M.F. of the dynamo negative, and the large currents, amounting sometimes to thousands of ampères, which had to find their way to the earth plates at the power house carried destruction in their path. But disappearance of these troubles has followed efficient bonding of the rails and the provision of complete metallic currents of suitable conductivity—in other words, the substitution of a metallic *earthed* return for an *earth* return.

In dealing with distribution for electric lighting purposes we do not have to contend with such large differences of potential at different points of the system, and the difficulties are not at all comparable with those encountered in street car work. A three-wire system with the middle earthed, and concentric wiring on each side with the sheathings connected to the middle wire, is an ideally safe and reliable system of distribution. In a well-balanced three-wire system the fall of volts along the middle wire is negligible, and there is therefore no danger of electrolysis. No disturbance to telephones could take place. Stray currents passing between faults in the conductors would be impossible. The positive and negative conductors being each surrounded by an earthed sheathing, no current can escape from them. Leaks in concentric cables will not endure. The distance between the inner conductor and its sheathing being only the thickness of the insulation, a fault develops at once into a short circuit, which is internal to the sheathing of the cable, and the fuse at once comes into operation. But it must be repeated that faults are much less liable to occur in concentric cables than in double wiring. The importance and safety of the self-testing properties of concentric wiring must be obvious.

As distributing networks are enlarged and extended, and the number of consumers increases, it becomes cumulatively more difficult to keep up the pretence of insulation. The present supposed insulation of the three wires is a sham, and the sooner we acknowledge it the better. Experience has proved that good insulation of all three conductors in an extensive network cannot be reliably maintained. Then why not face the difficulties, and end them by earthing the middle wire?

The initiation by Mr. Sidney Baynes of the use of 200-volt lamps

and 400-volt distribution on the three-wire system, has a significant bearing upon this question. That his policy from the supply engineer's point of view is a sound one is beyond doubt, and that it will be largely followed in the near future is certain. But what about the interior wiring? If the attempt is to be continued to maintain the insulation of all three wires, the possibility is introduced of having a difference of potential of 400 volts between one of the wires and earth. The danger from leakage across damp woodwork and the like is therefore much increased, and possible danger to life introduced.

Recent developments and experience demand the reconsideration of this question of earthing in its relation to electric light conductors. The Board of Trade have issued regulations referring to the use of uninsulated conductors for tramway and railway work. The time is ripe for the framing of regulations relating to an uninsulated middle wire in the three-wire system of distribution.

THE ARC LIGHT.*

By Prof. SILVANUS P. THOMPSON, D.Sc., F.R.S.

Lecture III.—Delivered January 28th, 1895.

(*Continued from page* 718.)

In fig. 25 we have the Crompton-Pochin lamp—of which the brake wheel part is practically identical with the Crompton-Crabb brake wheel (fig. 24); but instead of having a long solenoid, with an iron core, to be pulled by a lever, there is a series coil and a shunt coil at the top of the lever working the see-saw. One might point to other lamps of modern type, in which the same see-saw arrangement has survived the less effective forms. In the latest Crompton-Pochin lamp the see-saw operates a band brake. The lamp hanging before you is the form of lamp now produced by the Brush Company, under the name of the Brush-Vienna lamp. I believe the greater part of its mechanism is due to Mr. Kremenetsky, of Vienna.

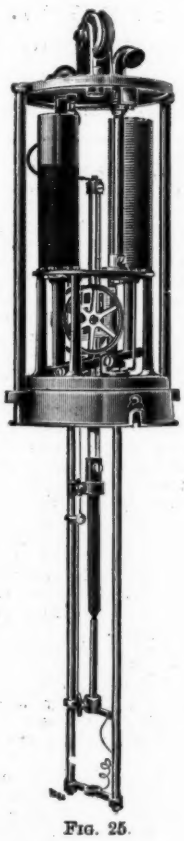


Fig. 25.

It has a series coil, and a shunt coil, and a see-saw working between them. As in many other Continental lamps in which clockwork or wheelwork is still employed, the operation of the electro-magnets of the lamp is to rock over the clockwork bodily, both for striking the arc and for determining whether the feed shall occur or not. You will find that in a very large number of lamps that have developed of late years, the question whether the train of mechanism shall or shall not be permitted to turn is made to depend on the position of the wheelwork as a whole, and the wheelwork is turned round on some convenient axis. One's mind travels back to 1882, at the time of the Crystal Palace Exhibition, when there was a lamp with tilting clockwork in it, shown by Mr. Brockie; a lamp which was never extensively employed, because Mr. Brockie went on to higher things.

Development of Siemens's Lamp.

We have here, amongst other pictures, a whole series of German lamps developed by the house of Siemens, illustrating the progress of invention so far as that firm * are concerned.

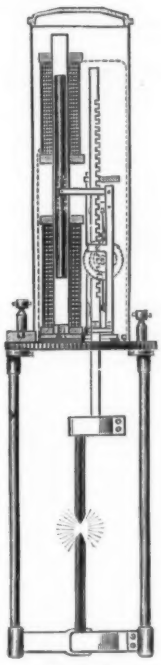


Fig. 26.

In one of these (fig. 26) the differential principle is introduced. The upper carbon is supported by a rod on which teeth are cut, which engage with a small pinion mounted on a frame. The pinion is only allowed to turn by driving a pendulum by means of an escapement, so that the feed will go on slowly but continuously so long as the series coil is not in action. When the current is turned on, the frame containing the escapement and carbon rod is lifted, striking the arc, and the top of the pendulum becomes fixed in a little nick.

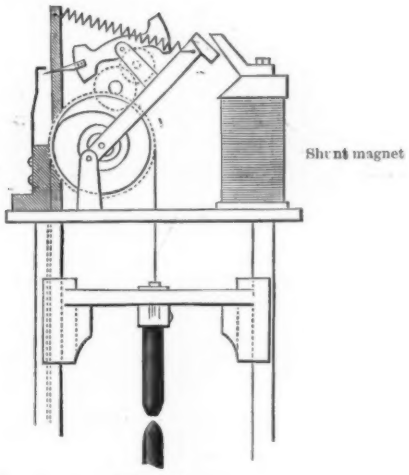


Fig. 27.

If the arc burns too long, the shunt coil brings down the frame, giving immediate relief, and when the frame has moved a little distance the pendulum is released, which in slowly allowing the escapement to operate gives permanent relief by feeding the carbon forward.

Now we come to the "flat-topped" lamp. It was a great thing to

* Cantor Lectures. From the *Journal of the Society of Arts*. References to this series of Cantor lectures will be found in the Electrical Review for January 18th and 25th, and February 1st, 1895.

* See Alexander Siemens in *Journal* Soc. Telegr. Engineers, 1880, p. 97.

get rid of these very long carbon rods with their racks, as they took up so much vertical space. In this lamp the carbons were simply clamped to a cross-piece, top and bottom. The top cross-piece was gradually screwed down by an arrangement with a gear vibrating, almost like an electric bell mechanism, which took up a wheel tooth by tooth, and so drove the screw-feed down. This was the precursor of a much more important lamp that the firm of Siemens has been putting out for the last half dozen years.

In Siemens's "band lamp" shown in (fig. 27) we see that the carbon is clamped into a heavy holder; there is no long carbon rod, the carbon is suspended on a flexible band or cord of woven copper, that goes over a drum, inside which there is a spring. The weight must be so heavy that it will uncoil that spring, and when you lift it up to put in a new carbon, the spring coils itself up again. This mechanism has two toothed wheels to multiply motion, and then an escapement (with a little piece sticking out at the end of it), and the whole is carried on a frame, which can be tilted. This, again, brings

Fig. 28.

us back to the tilting wheelwork which Mr. Brockie had in 1882. In the present case the only magnet is a shunt-wound electro-magnet working against a spring. Supposing there is no current supplied to the lamp, that magnet does not pull; the spring pulls back the frame, and the clockwork is locked. When the lamp is put on a circuit, there is no way through it except through the shunt; the magnet will therefore pull the armature forward, which motion will lower the upper carbon a little towards the lower carbon, and make them touch; or if they do not touch, it releases the escapement, and that will work, letting the upper carbon descend until they touch. The moment the main circuit is thus completed, there will be less

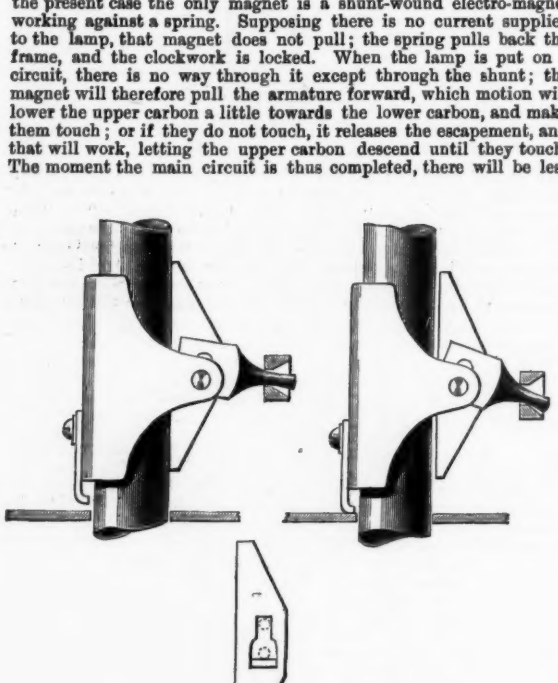


Fig. 29.

current going round the shunt, the spring will therefore rise, and the clockwork will be locked until such time as it is necessary for feeding to occur.

A Belgian lamp, described in 1889, illustrates this feature of the rack and wheel work turning on a pivot, which is so often found in Continental lamps.

The exclusive use of a shunt coil without any main circuit coil, though it was not well known, is a feature which has existed a long time. There was the Lontin lamp, of 1877, a variety of the Serrin. This is the first case of a lamp working only by a shunt coil. The Serrin had a series coil to pull down a jointed parallelogram to prevent the feed occurring. In the case of the Lontin amp, the jointed parallelogram was raised by the operation of the shunt coil, and the feeding mechanism released, which otherwise was locked when the frame descended by its own weight. Many lamps with shunt coils only are now in use.

Improvements in Clutch Lamps.

There are a few other types which have developed since 1889, amongst them the clutch lamps. The next few diagrams relate to clutches that have been developed since that time. The first (fig. 28) is that of the Helios Company. Here the actual carbon comes down in front of the pole of an electro-magnet, which has a deep groove in it against which the carbon slides. A small iron armature with an adjusting screw is made to grip against that carbon rod with a sort of knee-joint above, and holds the carbon rod as long as that electro-magnet does its duty, but as soon as the electro-magnet ceases to pull, as can be arranged by differential winding, the clutch releases the carbon rod, lets it slide a little bit, and then catches it again. This necessitates an independent arrangement for striking, but it is interesting as a form of clutch.

Then we come to the improvement in 1893 of the Brush lamp, by Mr. Adams, one of the engineers of the Brush Company in Cleveland. In the old Brush the clutch was a simple ring or washer, which gripped the carbon rod and raised it. That was replaced by Mr. Adams by a nipping clutch (fig. 29), with a separate toggle joint arrangement, which, in one position, pulls the clutch piece away from the carbon rod, and allows it to slip, and in the other position nips it against the rod and holds it up. The question whether the brake-piece is to be allowed to advance towards the rod and hold it, or to retreat from it, depends upon the position of the arm which comes down from the solenoid above, and depends on the larger portion of the clutch being allowed to come down into contact with the floor of the mechanism of the lamp. I have here for exhibition two lamps of the Brush Company's manufacture. One is an example of the Brush-Adams lamp, the other a Brush alternating current lamp, with laminated iron cores for the solenoids, and having the old kind of clutch.

(To be continued.)

WATER-POWER: ITS GENERATION AND TRANSMISSION.*

By SAMUEL WEBBER, Charlestown, N.H.

An examination of the detailed schedule of subjects submitted by the Council, as desirable topics on which to prepare papers for the current year, has induced the writer to offer the following notes on the first portion of the data requested by said schedule, which, it seems to him, it is desirable to preserve in such permanent form as will be given them by a place in the *Transactions*.

The first topics suggested, the storage of water supply, and the cost of its development and maintenance, seem to belong more particularly to the civil than to the mechanical branch of the engineering profession; but as the utilisation is mechanical, and the whole matter is intimately connected, it seems proper to offer a few general notes on the subject of the supply of water necessary for its mechanical utilisation.

The engineers, who have been for many years engaged in the question of water supply for large cities, have laid it down as an established fact that, by means of proper and complete storage basins, one-half the annual rainfall may be thus saved, the other half being either absorbed by vegetation or dissipated by evaporation.

This amount has been usually estimated for our northern cities as 1,000,000 gallons per day from each square mile of drainage area, or one-half an annual rainfall of 42 inches, which is a fair average for the larger part of the United States, east of Kansas and Nebraska, rising, according to Blodgett, as high as 50 and 55 inches, in parts of the south western States, but a safe estimate for the area of drainages from the great Appalachian range, which is as wide an area as we propose to consider in this paper.

It will be readily seen that this annual rainfall of 42 inches amounts to nearly 732,000,000 gallons on a square mile, so that 1,000,000 gallons per day is almost exactly half of it. To secure this half, however, requires the most complete and perfect system of storage basins possible, and it is not safe to calculate on such an amount as being available for water-power by any possible and economical means of storage.

It is possible, however, by practicable means of storage, to secure about one-third of the rainfall, and as water for power purposes is usually measured in cubic feet per minute, or per second, instead of gallons, we will now adopt that mode of computation.

An annual rainfall of 42 inches is equal to 267,409 cubic feet per day on a square mile, or 3·09 cubic feet per second, and if we take one-third of this, or 1 cubic foot per second, from each square mile of drainage area, we arrive at the supply which can usually, by the aid of storage, be relied upon.

The late James B. Francis, for many years the engineer of the Locks and Canals Company, at Lowell, on the Merrimac River, once gave me the following data, as the result of many years' observation of the flow of the Merrimac River, which, however, does not take in the

* To be presented at the New York meeting (December, 1895), of the American Society of Mechanical Engineers.

few days of "spring freshets," when the snow is going off the mountains, and the river so high and swollen as to be practically unmeasurable:—

Spring flow ... ... = 90 cubic feet per minute per square mile.
"June flow," about the average... ... = 55 " " "
Minimum flow in August and September = 30 " " "

The minimum flow has, however, been less than that once or twice in recent years, as, in 1881, it was only 26·7 cubic feet per square mile drainage area, or ·445 cubic feet per second. This diminution has been due to the destruction of the forests around the head-waters of the river, and such foreign destruction must be borne in mind by every engineer as a probability, when making estimates on a projected water-power.

It will be seen that this 30 cubic feet per minute, or 0·50 cubic feet per second, the minimum flow, is but one-sixth of the rainfall, and in order to secure the one-third, which I have considered as available, a sufficient "pondage" must be secured above the dam, at the proposed water-power, or in some other convenient location, to store the night flow, if the water is used in the daytime, or *vice versâ*, so as to get a double quantity during working hours, without too much diminution of the working head.

This is practically accomplished at Lowell, where the observations on the water-power of the Merrimac River have been longer continued and are more complete than any others of which I am aware, by the pond made by the dam. This pond is 18 miles long, with an average width of 500 feet. The drainage area of the Merrimac, above Lowell, is 4,093 square miles, and if we take the minimum flow as 0·50 cubic feet per second, we have a total flow of 2,000 cubic feet per second.

Col. James Francis, who has succeeded his father as agent and engineer of the Locks and Canals Company, informs me that, with 3 feet of "flash boards" on the dam, giving a fall of 34 feet, they can store in this pond, at a depth of 1·50 feet, 71,874,000 cubic feet of water, which, if drawn down the 18 inches in 10 hours, would give them 6,165 horse-power, which, added to the daily flow of the same 2,000 cubic feet, would give at low water a total of 12,330 horse-power. The original estimate of the power available at Lowell was 10,000 horse-power on 30 feet fall; but by raising the dam above, and removing obstructions below, this power has been increased, as shown.

The net effect of the present turbines in Lowell is here taken at 80 per cent. There are, however, in place, at Lowell, turbines enough to utilise 20,000 horse-power, for which water is furnished for a portion of the year, but which have to be supplemented by steam engines to supply the deficiency, when the water is reduced to the minimum flow, as above quoted.

In addition to this, the mills at Lowell, Lawrence, and Manchester, N.H., have also derived great benefit from the use of the water stored in Lakes Winnepesaukee and Winnesquam, in New Hampshire, where the outlets were deepened, and weirs and gates put in below, enabling the water-power companies to draw down these lakes in the summer to a depth of 12 feet below the full height in spring, or 6 feet below their normal summer level. The area of these lakes above the Lake Company's dam is 71·8 square miles; and Col. Francis gives me the following data of the amount of water furnished by them for several consecutive years:

Year.	Horse-power furnished for three months.	Depth drawn at lake. Feet.
1878	659	4·20
1879	809	5·16
1880	1,299	8·28
1881	1,600	10·20
1882	1,506	9·60
1883	282	1·80
1884	1,845	11·76
1885	69	0·44
1886	1,067	6·80
1887	0	0·

The variation in seasons is seen to be considerable.

Leaving this branch of the subject, with the repetition of the statement that, by storage, one-third of the rainfall can be relied on for power for day *or* night, I now take up the question of turbines.

The modern turbine is the evolution of ages from two distinct types, one of which delivers the water in a tangential direction to radial arms or vanes, projecting from a central shaft, without confining it in any way; the other conveyed it in a closed tube to hollow radial arms, through which it passed, and leaving them in a tangential direction, gave, by the reaction pressure, a rotary motion to the whole apparatus.

We can trace both systems back to such remote antiquity that it is useless to attempt to find the origin; and as the principal developments of both have been made within the present century, we need go back no farther. As we shall devote much less time to the second of these types, or the "outward discharge," we shall consider it first, and simply refer to the well-known "Barker Mill," or the "Whitelaw and Sterret," sometimes called the "Archimedian" wheel, as the first modern type of this style.

In 1827, Mr. Fourneyron applied this principle of the outward discharge from a pipe to a wheel with curved buckets placed outside of the apertures of discharge, so as to receive the water in a direction perpendicular to the first and inner element of the curve, which appears to be practically cycloidal, and which, revolving from the action of the water, finally discharged it at its outer element at the circumference, with its force exhausted; *i.e.*, the best results obtained from this form of turbine were shown by Mr. Francis, in his "Hydraulic Experiments," to be when the circumference of the wheel at the point of discharge had reached the velocity due to the water under the fall, or 62 per cent. of theoretical velocity due the head, from the action of gravity, this being the result of what is known as the "contracted vein." At this velocity of the wheel the water falls away dead into the pit, to take a new direction due to the fall in the "tail-race."

In the Fourneyron turbine, the tube, or feeder, which supplied the water, was closed at the bottom by a concave cone surrounding the wheel shaft, which passed up through it in a pipe, and was not exposed to the water. This cone was surrounded by a number of guide plates, curved like the buckets, but in the opposite direction, and fastened to the cone; and these delivered the water to the buckets in the proper tangential direction. This first turbine of 1827 was followed by another, in 1834, of 7 or 8 horse-power, which worked at times under a head of only 9 inches.

Then came several others, under higher heads, of 63, 79, 126, and 144 feet respectively, giving from 71 to 87 per cent. net effect of the power of the water.

(To be continued.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 31, *High Holborn, London, W.C., to whom all inquiries should be addressed. Copies of any of the specifications may be obtained of* Messrs. W. P. Thompson & Co., *price, post free* 8½*d. (in stamps.)*]

NEW PATENTS.—1895.

20,925A. "Improvements in or relating to incandescent electric lamps." E. Burnet. (Date claimed under Patents Rule 19, November 5th, 1895.) Dated November 28th.

22,480. "Improvements in dynamo-electric machines." H. Chitty. Dated November 25th.

22,447. "Improvements in or connected with the suspension of gas or other lamp shades." J. H. Stone and H. G. Atkinson. Dated November 25th.

22,482. "Manufacture of orange colouring matters by electro-chemical process." O Imray. (The Society of Chemical Industry in Basle, Switzerland.) Dated November 25th.

22,505. "Active material for electric accumulators." F. Dannert, H. Windolff, and J. Zacharias. Dated November 25th.

22,511. "Improvements in the production of bulbs for incandescent lamps." O. M. C. Heyl. Dated November 25th.

22,506. "Electric accumulator." F. Dannert, H. Windolff, and J. Zacharias. Dated November 25th.

22,519. "Improvements in or connected with electric railways or electric transport." F. C. Esmond. (Date applied for under Patents, &c, Act, 1883, Section 103, April 26th, 1895, being date of application in United States.) Dated November 25th.

22,543. "An improved carbon holder for electric arc lamps and projectors." G. Wilson. Dated November 26th.

22,569. "Improvements in or connected with electric bell pushes." J. W. Creasy and T. W. Breach. Dated November 26th.

22,570. "Improvements in shades for lamps and other artificial lights." A. C. Newcombe. Dated November 26th.

22,574. "Improvements in the manufacture of insulating compositions for electrical purposes." C. J. Geist. Dated November 26th.

22,575. "Improved carbon plates with or without terminals." F. H. Judson and C. W. Silcock. Dated November 26th.

22,586. "Improvements in single-phase alternate current motors." Siemens, Bros & Co., Ltd. (Siemens & Halske, Germany.)

22,600. "Improvements in and relating to a system of telegraphic communication." I. Kitsee. Dated November 26th.

22,660. "Apparatus to protect against danger from overhead electric wires." W. Thomson (Baron Kelvin). Dated November 27th.

22,661. "Improvements in apparatus for indicating and recording electric supply." W. Thomson (Baron Kelvin). Dated November 27th.

22,679. "Improvements in the construction of electric light fittings." G. Wadely. Dated November 27th.

22,686. "Improved automatic electro-magnetic interrupter, for protecting electrical installations." C. D. Abel. (Compagnie pour la Fabrication des Compteurs et Materiel d'Usines à Gaz, France.) Dated November 27th.

22,696. "Improvements in alternating current arc lamps." W. P. Thompson. (Wilhelm Mathiesen, Germany.) Dated November 27th.

22,717. "Improvements in telephonic apparatus." M. Koyra and C. Milde. Dated November 27th.

22,732. "Improvements in a process and apparatus for the electrolytic production of metallic zinc from ores of zinc, and metallic zinc and metallic copper, and the production of oxygen gas in the cases specified." C. A. Burghardt and G. Rigg. Dated November 28th.

22,733. "New or improved adjustable device for fastening glass globes, funnels, or shades to lamps, gas brackets, or similar supports." E. H. Prew. Dated November 28th.

22,736. "Improvements in electrical separators." S. P. Thompson and M. Walker. Dated November 28th.

22,783. "An improved attachment for telephone receivers." J. D. Greene and B. Warne-Browne. Dated November 28th.

22,793. "Improvements in and relating to electric vapour engines for vehicle and launch propulsion in particular." W. Rowbotham. Dated November 28th.

22,846. "Improvements in and connected with automatically operated electrical switches." F. G. Robinson. Dated November 29th.

22,860. "Telephone communicating system for expediting messages." P. Fergusson. Dated November 29th.

22,864. "Improvements in or relating to telegraphic receivers especially applicable for submarine telegraphy." A. Pierfort. Dated November 29th.

22,866. "Improvements in the extraction of copper from its ores by electrolysis." A. F. B. Gomess. Dated November 29th.

22,898. "Improvements in the manufacture of electrical fuse boards and other like articles." R. T. Grocott. Dated November 29th.

22,899. "Improvements in and connected with secondary batteries." J. E. Bousfield. (G. Dorville & Co., France.)

22,936. "Improvements in and connected with electrical commutators and collector rings, and collectors therefor." T. F. J. Truss. Dated November 30th.

22,939. "Improvements in electrical sounding apparatus." F. G. Griffith. Dated November 30th.

22,976. "Improvements connected with electric telegraphs, organs, condensers, deposition of nickel and cobalt, and with packing eggs and other fragile articles, and coating eyelets and such objects and making bleaching powder." J. Swinburne. Dated November 30th.

22,985. "A contact device for the transmission of electric current." C. Bremer. Dated November 30th.

22,987. "An improved electrical lamp and battery, especially applicable for use in bedrooms, but applicable for various other purposes." M. M. Harris and G. Cuthbert. Dated November 30th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

1895.

7,782. "Improvements in electric resistances." J. F. H. Voigt and J. A. Haeffner, Electrical Works, Bockenheim, near Frankfort-on-Main. Dated April 18th. Relates to the manufacture of electric resistances and consists in applying to porcelain, glass talc, or other suitable insulating material, a metallic coating containing metal in a very finely divided condition. The resistance thus produced may be at once employed for an electric rheostat, or when a gold or silver coating on porcelain be employed it may be burnt before use for the purpose of imparting to it greater durability. Large masses of the resisting material may be formed, or even separate special metal parts arranged at desirable points on the resistance for the purpose of conducting to or carrying off the electric current. Different methods of applying the coating are described. 1 claim.

12,329. "Improvements in and relating to telegraphic systems and instruments therefor." A. Merrel and A. Duffek, both of 3, Gerstengasse, Prague, Bohemia, Austria. Dated June 25th. Consists of a system and apparatus connected therewith, whereby messages telegraphed through the line are received by a printing instrument which is caused to print the message on paper strips in ordinary type. One set of the apparatus consists essentially of an electric type-writing instrument, an electric motor, key-board, two transmitters, two relays, an electric bell, two keys, an electric brake, whereby the speed of production of work is regulated, and of three separate electric batteries. The apparatus is described and shown in seven sheets of drawings, the novelties consisting of details pointed out in the claims. 6 claims.

12,498. "An improved compound for electrical insulating purposes." M. Merowsky, 6, Roon Strasse, Cologne, Germany. June 28th. Relates to an improved compound consisting of powdered mica conglomerated with wood or other fibrous pulp, glue and paraffine. These ingredients are preferably combined in about the following proportions to within about 60 per cent. of the powdered mica, 30 per cent. of the fibrous pulp, and about respectively equal proportions of the glue and paraffine. Other proportions may be used. 1 claim.

14,492. "An improved arc regulator for electric lamps." S. Prieto, of 126, Rambla de Cataluna, Barcelona, Spain. Dated July 30th. Relates to a lamp in which the top and bottom carbon holders are connected by a flexible string, the regulating magnet being arranged to strike the arc by acting on the string and at the same time to prevent the descent of the top carbon by braking a wheel round the axle of which the connecting string is led. The upper carbon holder formed of two parallel bars and united at their extremities by means of arms, the upper one of which containing the carbon being insulated, these arms being provided with forks or grooves to allow of their sliding smoothly along two exterior fixed bars which serve as guides to the movements of the carbon holder, the lower arm supporting two cups which may contain lead so as to regulate the weight of the carbon holder. 5 claims.

14,801. "Improvements in the electrolytic production of oxides and salts which are insoluble, or partly insoluble, in the electrolyte." Carl Luckow, Cologne-Deutz, Germany. Dated August 6th. This invention relates to the production from very weak solutions, by means of electrolysis, of metallic oxides and salts which are insoluble, or difficultly soluble, in the electrolyte. Metallic plates are arranged as alternately positive and negative electrodes opposite to each other with distances between each plate and the next of from 10 to 20 millimetres. The metal of which the anode is to be formed is determined by the solution to be treated and the precipitate to be obtained. Thus, for instance, if super-oxide of lead, or carbonate, or chromate, is to be obtained the anode is of soft lead, for the oxide and salts of copper a copper anode is used; for the zinc oxides and salts a zinc anode is employed, and similarly in all other cases the anode is of the same metal as the oxide or salt to be produced. The best results are obtained if the cathode is of the same shape, size, and thickness, and of the same metal as the anode. The production of lead carbonate chromate, also of black oxide of nickel, white oxide of zinc, the blue-green basic copper carbonate, the light blue acid copper phosphate, the white basic zinc carbonate, and many other similar salts is described. 2 claims.

14,842. "Improvements in electric condensers for use in polyphase and multiphase alternating currents." W. P. Thompson, 6, Lord Street, Liverpool. (C. S. Bradbury, Avon, N.Y., U.S.A.). Dated August 6th. Claim 3. A polyphase condenser comprising a series of conductive plates or surfaces separated by a suitable dielectric and provided with terminals for connection with a polyphase circuit, said terminals being electrically connected respectively in consecutive order with the several plates. 3 claims.

14,937. "Improvements in electric block signals for railways." A. C. Gordon, Rochester, U.S.A. Dated August 7th. Relates to those electric block signals for railroads, in which, where a train or car is on the block, a short circuit is established through the wheels and axle, thereby opening the main circuit that controls the signal and leaving a standing signal of "danger." On the removal of the train or car from the block the relay operates by closing the main circuit and changing the signal to "safety." The essential feature of the invention is the motor for drawing down the connection that operates the signal, and the electro-magnet for holding the same in its depressed position so long as the block is occupied. The magnet alone cannot produce the desired effect, as the throw is too great to enable it to act upon the armature. The motor draws it down within the reach of the magnet, and the latter seizes it and holds it, while the motor releases its hold. 5 claims.

15,365. "Improvements in and relating to electric switches." W. H. Dingle & J. M. Urquhart. Dated August 15th. Relates to quick break switches; the bridge piece of the switch when the circuit is closed is held by a catch in position to a spring which tends to open the circuit, the said catch is forced out of engagement with the bridge piece by means of a system of levers forming a knuckle-joint acted upon by suitable push-piece. 2 claims.

15,886. "Improvements in or connected with electric batteries." C. J. Wollaston, 31, Notting Hill Terrace, London. Dated August 23rd. The invention relates to improvements on Patent No. 669 of 1894, having mainly for object to provide means for grouping a number of the cells or batteries "in series" compactly in a carrying plate or frame in such a manner that the act of applying any single battery in the plate establishes electrical contact between the terminals thereof and junction strips or conductors are so arranged that one or any number of the cells or batteries can be thrown into circuit by a plug inserted between the junction strips or conductors. 1 claim.

16,008. "An improved telephonic instrument designed for use on poorly insulated lines such as the existing wires of an ordinary wire fence." G. Dillberg, Glen View Street, Paddington, Sydney, and P. Rabbidge, Double Bay, Sydney, New South Wales, Australia. Dated August 26th. The transmitting current passes through the transmitter, and the primary of an induction coil, also if the line is badly insulated, through the secondary of the induction coil which is in series with the receiver, and is connected between the transmitter and the line. The batteries at each end of the line are in opposition so that if the line is well insulated no current passes through it direct from the battery. The call bell is in a local circuit closed by a relay which is formed of the induction coil. 4 claims.

16,439. "Improvements in dynamo electric machines." F. H. Royce, Eastbourne, Holland Road, Chorlton-cum-Hardy. Dated September 3rd. Relates to automatically opening and closing a ventilator or door of a generator known as of the "enclosed" type. The coil magnet is excited by the same current that passes through the generator, and it will consequently be seen that immediately the current has ceased to pass through the generator the coil will become de-energised and the arm of the door being no longer held, the door will fall of its own weight into a vertical position and thus close the opening. On starting the machine again, it will be opened. 1 claim

16,939. "Improvements in electric locomotives." J. Devonshire, 38, Parliament Street, Westminster. (E. W. Rice, jun., Schenectady, New York, U.S.A.). Dated September 10th. Relates to a self-contained electric locomotive capable of running on existing railway trucks without a central station and outside line connection. The locomotive comprises a boiler capable of furnishing the desired amount of steam to a prime mover of any suitable description, such as a compound condensing engine, the engine driving a direct-current generator supplying current to a rotary transformer, which in turn supplies alternating current to the motors mounted on the car axles. The speed of the motors may be varied by varying the excitation of the field magnet of the generator or the transformer. 4 claims.